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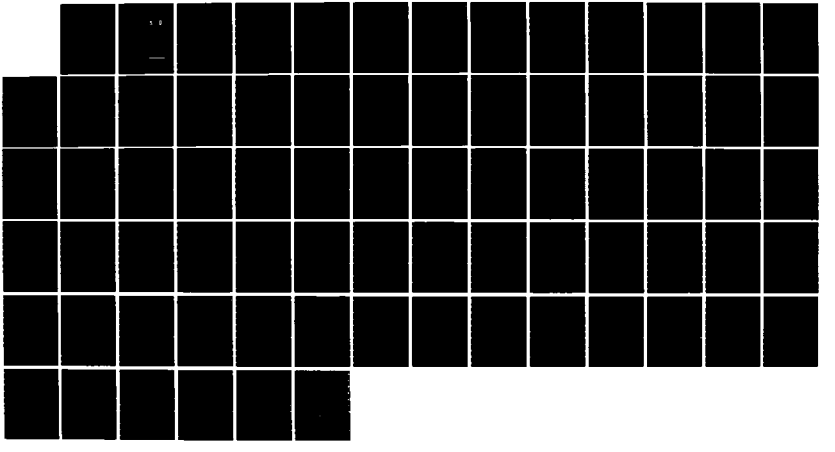

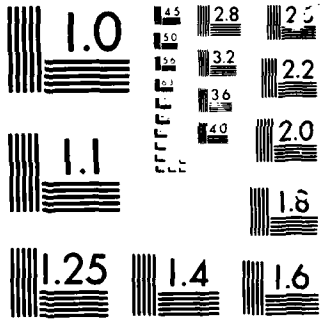

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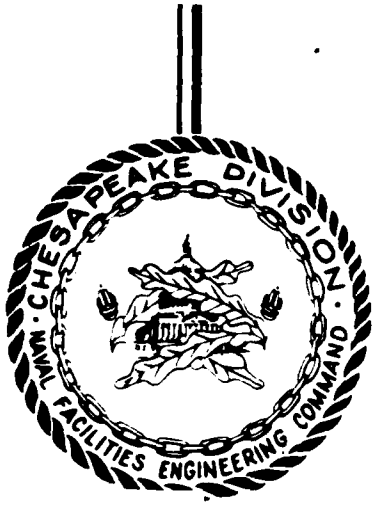

WEST COAST OCEAN CONSTRUCTION PLATFORM ECONOMIC ANALYSIS

FPO-1-78(13)
AUGUST 1978

[redacted]

OCEAN ENGINEERING AND CONSTRUCTION PROJECT OFFICE
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, D.C. 20374

FPO-1-78(13)

WEST COAST OCEAN CONSTRUCTION PLATFORM

ECONOMIC ANALYSIS

Prepared By

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August 1978

Prepared For

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In an effort to promote a higher degree of Fleet readiness, consistency of operations, efficiency resulting in decreased fuel oil consumption and to provide specialized capability allowing timely completion of Fleet required ocean construction project; it is proposed to acquire an ocean
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construction platform dedicated to the needs of the Fleet in the Pacific Ocean, primarily on the West Coast and at Hawaii. This economic analysis compares the life cycle costs of the proposed alternative with two other alternative methods of accomplishing the NAVFAC Fleet support mission tasks.

FOREWORD

An economic analysis was performed in conjunction with the West Coast Ocean Construction Platform, Preliminary Design Study conducted by Global Marine Development Inc. (GMDI) under contract No. N62477-78-C-0004. The Preliminary Design Study Report (Report # FPO-1-78 (9), Volumes I and II) provided the operational cost data associated with the three alternative methods used for investigation in this economic analysis. The acquisition costs of Alternative A, the dedicated ocean construction platform, were also documented in GMDI's study. The techniques and procedures used in this analysis were in accordance with DoD, SECNAV, NAVMAT and NAVFAC instructions and guidelines.

RE: FOUO, Distribution Statement A
Delete the FOUO statement on this report.
Per Ms. Jacqueline B. Riley, NFEC/Chesapeake Division

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SUMMARY

In an effort to promote a higher degree of Fleet readiness, consistency of operations, efficiency resulting in decreased fuel oil consumption and to provide specialized capability allowing timely completion of Fleet required ocean construction projects, it is proposed to acquire an ocean construction platform dedicated to the needs of the Fleet in the Pacific Ocean, primarily on the West Coast and at Hawaii. This economic analysis compares the life cycle costs of the proposed alternative with two other alternative methods of accomplishing the NAVFAC Fleet support mission tasks. The three alternatives considered are:

A. Dedicated platform (Navy owned)
B. Charter (status quo option)
C. Contract (turn key operation).

The operational costs are dependent upon the average number of project execution days per year over the 20-year economic life of the analysis. For all three methods the life cycle costs have been estimated using a baseline execution schedule of 135 days per year and for minimum and maximum schedules of 90 and 180 days per year respectively. The resulting costs in 1978 dollars are plotted in Figure 1 and the relative ranking of the alternatives may be seen for any number of day's work per year that is of interest. Total life cycle costs of Alternative A, the proposed option, are significantly influenced by acquisition costs. Therefore, two curves are plotted in Figure 1 to show the affect of a variance in the initial cash outlay for the dedicated platform. From Figure 1, the break-even points are seen to occur from 42 to 82 project execution days per year.

When one considers the life cycle costs in terms of current year dollars (escalated at a constant rate over the 20 years to better represent the real amount of dollars to be expended) the significance of the acquisition cost of Alternative A diminishes greatly. Using a rate of 8% escalation per

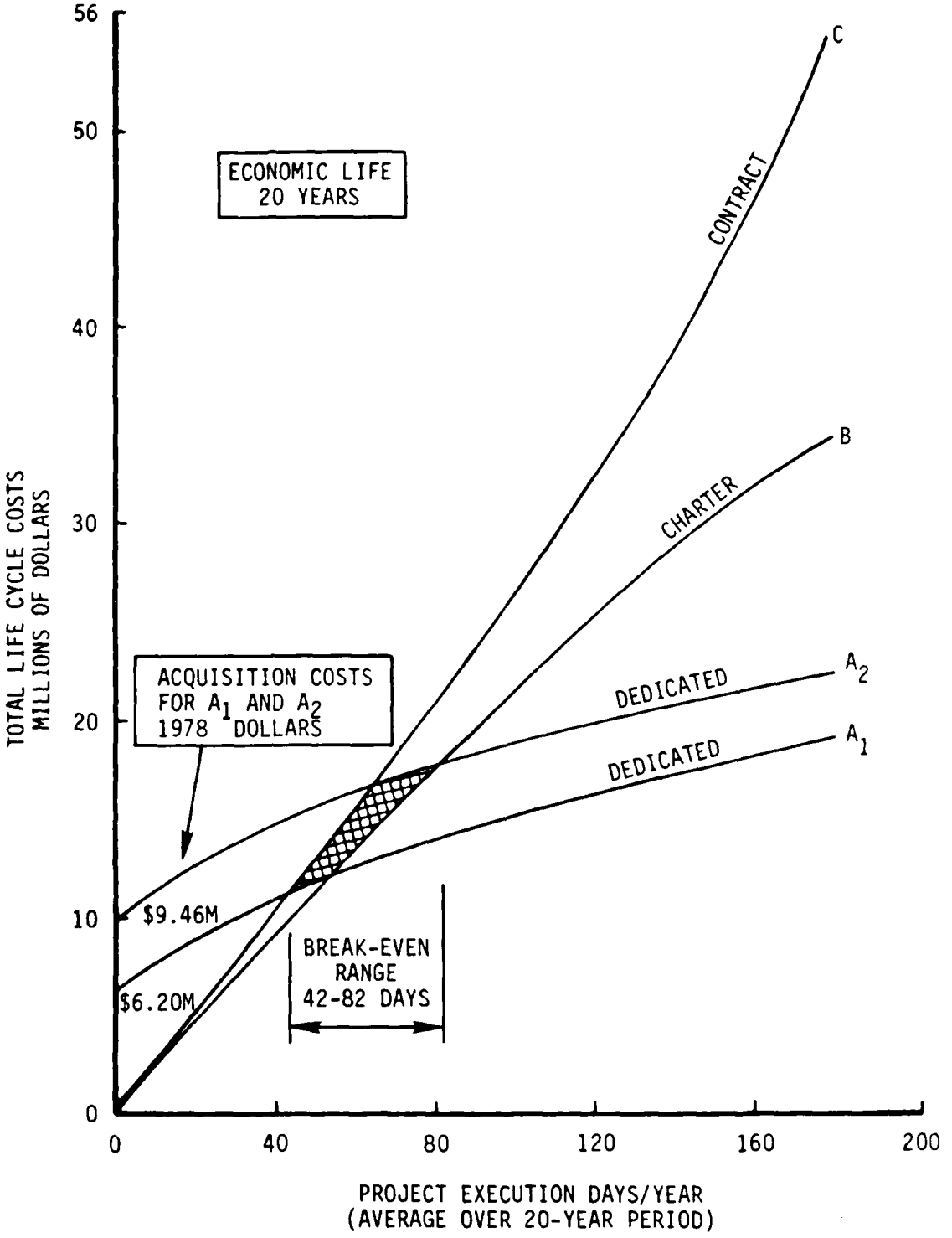

Figure 1. Total Life Cycle Costs in Constant 1978 Dollars

year, total life cycle costs in current year dollars for the baseline case of 135 days/year are estimated to be as follows:

(A)	Dedicated	$48,650,000
(B)	Charter	$94,170,000
(C)	Contract	$124,630,000

Figure 2 presents current-year dollar costs as a function of execution days per year. A break-even range of 22 to 35 days per year is shown.

Net Present Value (NPV) comparisons of the three alternatives are shown in Figure 3 as a function of the differential inflation rate (DIR). The baseline case of 135 days of project execution per year is used for this summarization. As indicated in Figure 3, option A_1 has the lowest NPV at any differential inflation rate. The charter option, B, has a lower NPV than A_2 from a rate of 0% to 2 1/2%. The contract option has the highest NPV in any case. In the area of concern (4% to 8% - which best represents costs anticipated in the ocean construction business over the economic life of years 1982 to 2002), the dedicated Alternatives A_1 and A_2 have the lowest net present values.

The consumption of Diesel #2 fuel oil by the three methods of performing ocean construction tasks was investigated.

Fuel consumed per mission day was estimated to be as follows:

(A)	Dedicated	4.8 long tons/day or 40.8 barrels/day
(B)	Charter	9.8 long tons/day or 83.3 barrels/day
(C)	Contract	6.1 long tons/day or 51.9 barrels/day

For the baseline case of 135 days/year, the total fuel consumed over 20 years for each of the three alternatives is as follows:

(A)	Dedicated	13,068 long tons or 111,078 barrels
(B)	Charter	26,036 long tons or 221,306 barrels
(C)	Contract	11,852 long tons or 100,742 barrels

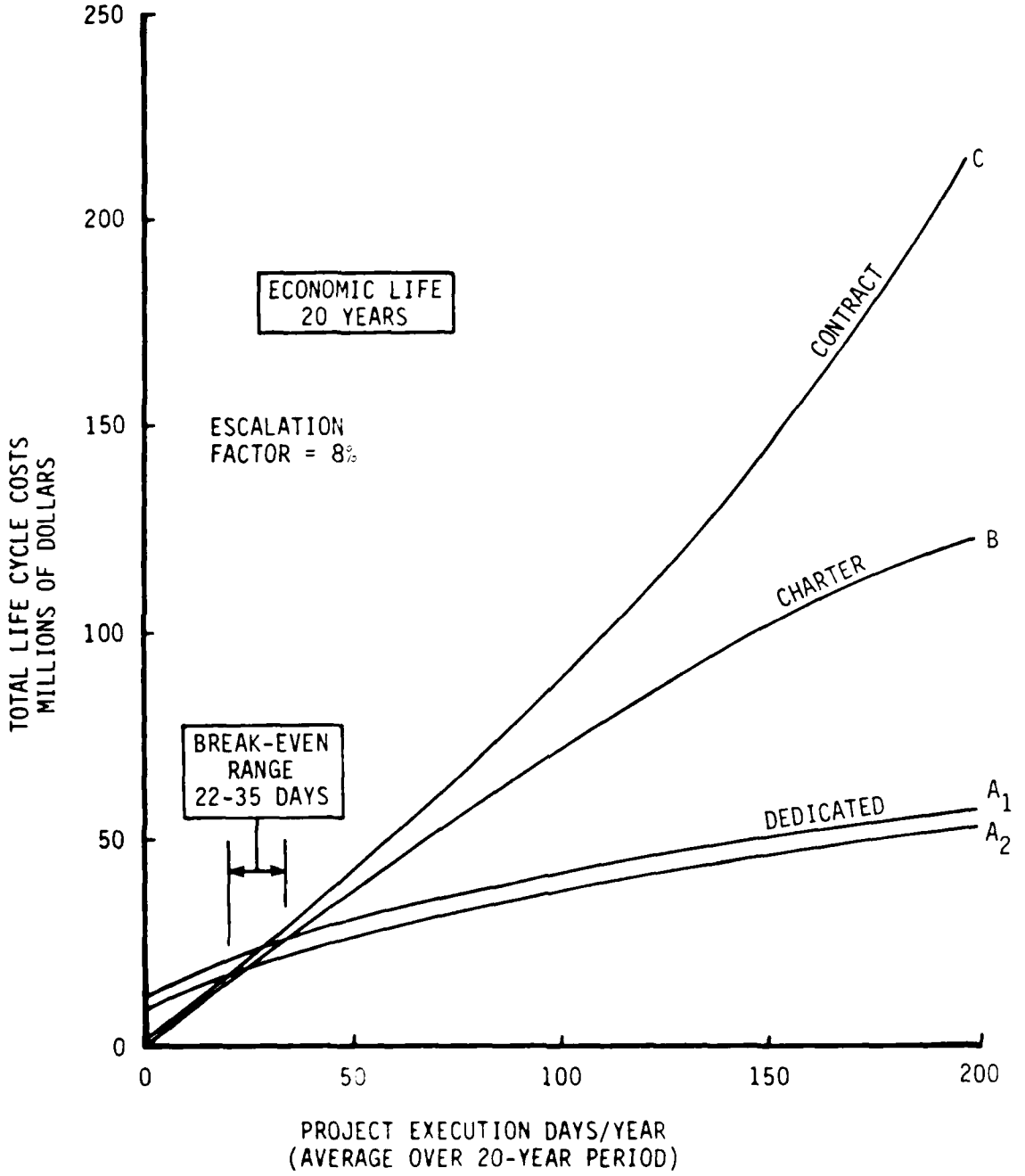

Figure 2. Total Life Cycle Costs in Current Year Dollars

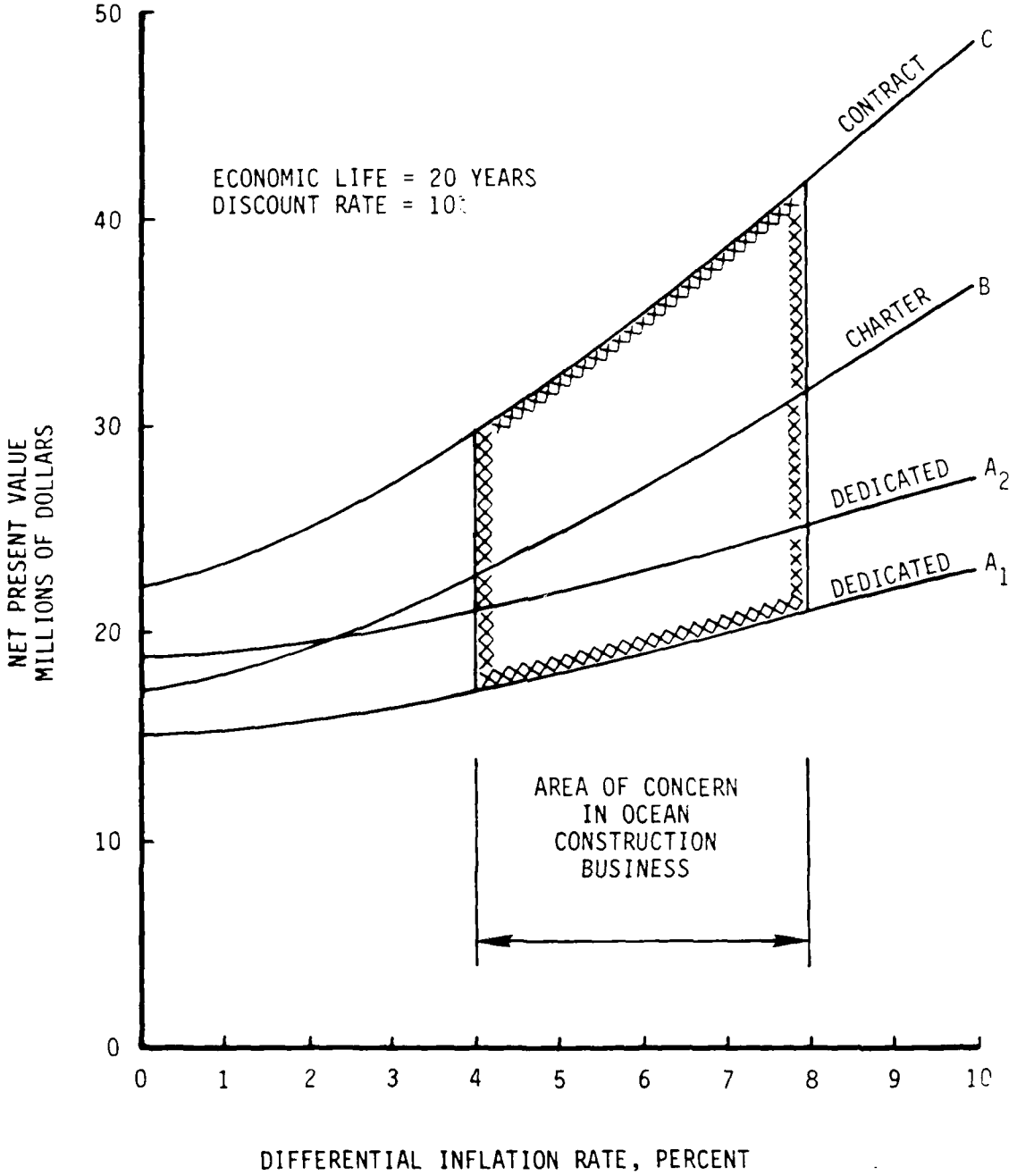

Figure 3. Net Present Value of Total Life Cycle Costs, Baseline Case of 135 Days/Year

It is noted that while option A (Dedicated) is more efficient using the least amount of fuel on a per day basis, option C (Contract) is more efficient over 20 years using slightly less fuel than option A. The status quo option B consumes approximately twice as much as either the dedicated or contract. The reason that the contract option uses less fuel over the 20 years is inherent in the definition of the contract option whereby the work is performed continuously through the use of crew shifts and results in shorter total times for accomplishment of the projects. The baseline case of 135 days/year was established for the dedicated option. The other two options perform to that baseline taking 133 days/year for (B) charter and only 97 days/year for (C) contract options.

In view of the differences in total costs of A and C, the small difference in fuel consumption between A and C is not significant. An item of major significance is that the price of Diesel #2 fuel is escalating at a rate of 16% thru 1980 and 14% thru 1983 (Reference 7) and for the long term, NAVFAC guidelines use a 9% differential inflation rate (Reference 6).

The total life cycle costs of fuel oil consumed for the baseline case of 135 days per year are estimated three ways (1) in constant 1978 dollars, (2) in constant 1982 dollars - at the beginning of the economic life and (3) in net present value using the 9% differential inflation rate as called out in Reference (6). These values are summarized below.

Total Life Cycle Costs Diesel #2 Fuel

1. Constant 1978 dollars (today)

A.	Dedicated	$1,385,000
B.	Charter	2,760,000
C.	Contract	1,256,000

2. Constant 1982 dollars (Beginning of economic life)

A.	Dedicated	$2,422,000
B.	Charter	4,826,000
C.	Contract	2,197,000

3. Net Present Value (9% Differential Inflation Rate)

A.	Dedicated	$2,213,000
B.	Charter	4,404,000
C.	Contract	2,006,778

1.0 THE ALTERNATIVES

Three alternative methods of accomplishing NAVFAC's ocean construction mission in the Pacific waters (West Coast and Hawaii) were analyzed.

The proposed Alternative (A) makes use of a Navy owned ocean construction platform manned by Navy civilian and underwater construction team personnel and outfitted with specialized equipment from NAVFAC's ocean contruction equipment inventory. Personnel would not work weekends. Alternative A is referred to as the "dedicated" option throughout this economic analysis.

The status quo Alternative B considers the chartering of available offshore work boats, ocean going barges and tugs including the crews required to operate these vessels. The construction crew would be made up of Navy civilian and underwater construction team personnel. Roll on/roll off equipment from NAVFAC's specialized inventory would be added to the chartered vessels. In most cases, modification of the chartered vessels would be required in order to perform the mission. After the mission is completed, the vessels would be put back in the same condition as existed prior to conducting operations. Personnel would not work weekends. Alternative B is referred to as the "charter" option throughout this economic analysis.

Alternative C considers contracting on a 5-year term with a commercial firm to perform all missions within that time frame without the need of Navy assets (either personnel or equipment). An existing vessel would be converted to an ocean construction platform similar in performance to the Navy owned platform of Alternative A. The operational and construction crews would work in shifts until the project was completed including working on weekends. The Navy would provide one on-site government representative for each project. Alternative C is referred to as the "contract" option throughout this economic analysis.

2.0 ECONOMIC AND PROJECT LIFE

The economic life of the analysis begins when the benefits of all three alternatives are available. Based on the POM 81 submittal for acquisition of a West Coast ocean construction platform (Alternative A) benefits will start in the 1982 - 83 time frame. The year 1982 is considered the zero year of this economic analysis. Guidelines from DoD and NAVMAT suggest that economic lives for ocean vessels should range from 15 to 30 years (Reference 4). For this analysis, life cycle costs have been estimated over a 20-year period. The project life encompasses four additional years from the present year 1978 to 1982 for a total of 24 years. All costs associated with the acquisition of Alternative A (Dedicated) are included in the analysis from the present time through the end of economic life in the year 2002. Alternatives B (Charter) and C (Contract) incur costs only during the economic life (1982 - 2002).

3.0 PROJECT EXECUTION WORKLOAD SCHEDULES

The life cycle costs of this analysis are primarily the operational costs of performing ocean construction work. The total operational costs for 20 years depends upon the type and duration of the individual project and the number of these projects executed during the economic life. During the preliminary design study (Reference 11) execution schedules were defined for three basic scenarios typical of NAVFAC's ocean facilities program mission tasks. Performance schedules were estimated for each of the three alternatives in execution of the three scenarios. Figures 4, 5, and 6 show the estimated number of days required to perform Scenarios 1, 2 and 3 respectively. The 20-year workload schedules are based upon a selected mix of the three scenarios for average workload of 90, 135 and 180 days per year, each year for the economic life. The baseline case of 135 days per year for Alternative A, the excursions of 90 and 180 days per year and the equivalent schedules for Alternatives B and C are described in the following paragraphs.

3.1 Baseline Case

The performance schedules of the proposed dedicated ocean construction platform were used in the establishment of the baseline case. Initially a five-year workload schedule was developed utilizing the three basic scenarios augmented by individual days of work similar to Scenario 2, the least cost per day type of operations. The user, project location, type and duration of projects to be considered in calculating the total operational costs are identified in Figure 7 for Alternative A with an average over the 5 years of 135 days/year. From this basic schedule, the excursions of 90 and 180 days/year average were developed.

3.2 Minimum/Maximum Excursions

Using the 135 day/year execution schedule, work was either subtracted or added to correspond with an average of 90 or 180 days per year execution. In all cases one each of the three scenarios was scheduled. Due to the variance in total number of days to perform the scenarios (No. 1 - 142 days, No. 2 - 38 days, No. 3 - 87 days) the individual yearly total of

project days varies. The 90 and 180 day/year project execution schedules for Alternative A (Dedicated) are shown in Figures 8 and 9. The use of the three schedules - baseline, minimum and maximum, allows for parametric analysis of the total life cycle costs in which comparisons of the three alternatives may be made at any number of execution days per year.

3.3 Equivalent Schedules

The workload schedules for Alternatives B and C are developed from schedules of Alternative A. This is done so that the amount of work performed is the same for any alternative.

It may be noted from the performance schedules of Scenarios 1, 2 and 3 (Figures 4, 5 and 6 discussed previously) that it takes less time for Alternatives B and C to perform than for A, the proposed option. Therefore, when the 5-year schedules are made up, Alternatives B and C have an average number of days/year less than that of A. The schedules for B and C are presented in Figures 10 through 15. This procedure of defining equivalent schedules provides equal performance benefits from all three alternatives during the economic life. Comparisons may then be made readily on a cost basis alone.

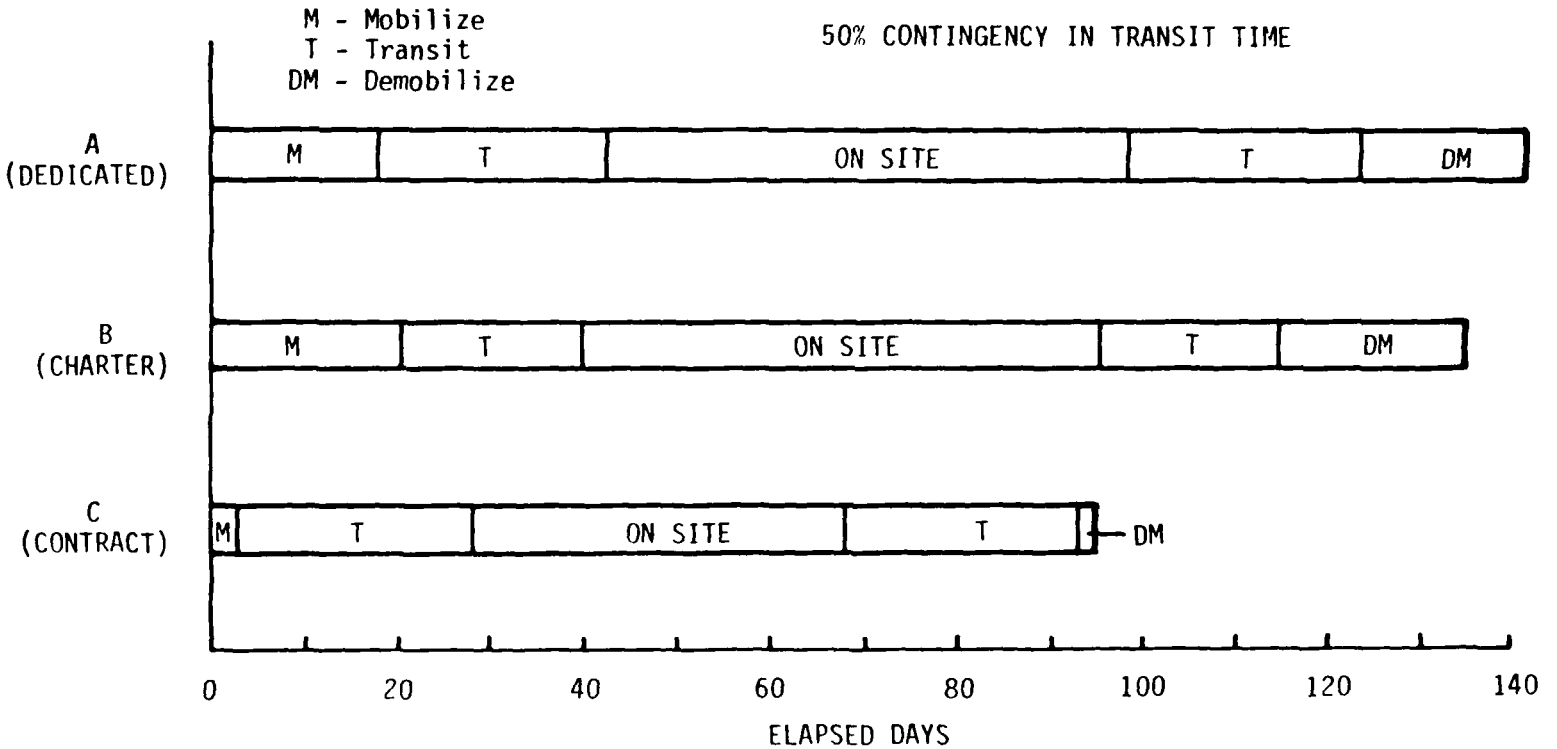

Figure 4. Performance Schedule - Scenario 1

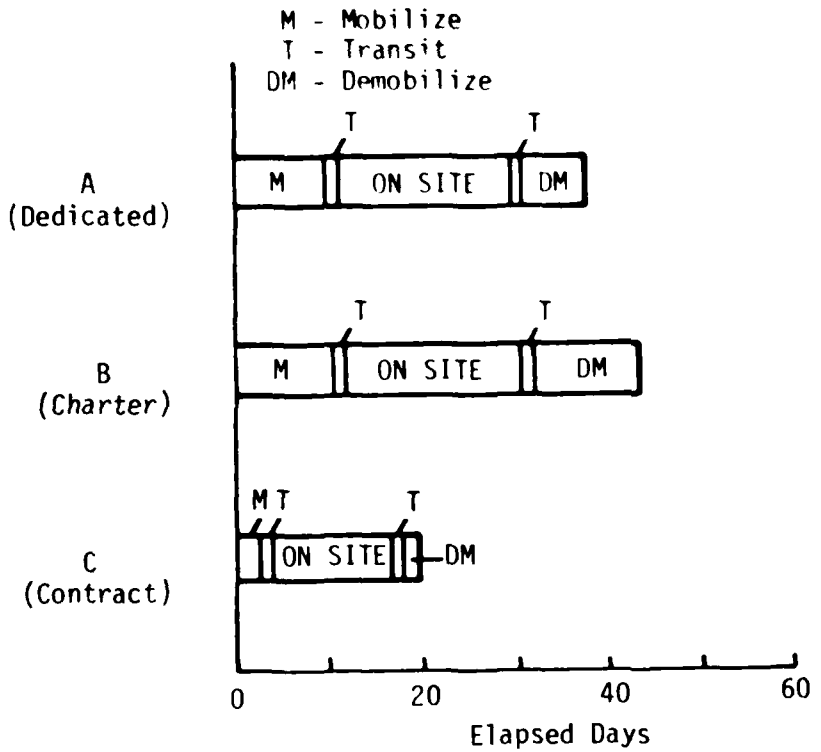

Figure 5. Performance Schedule - Scenario 2

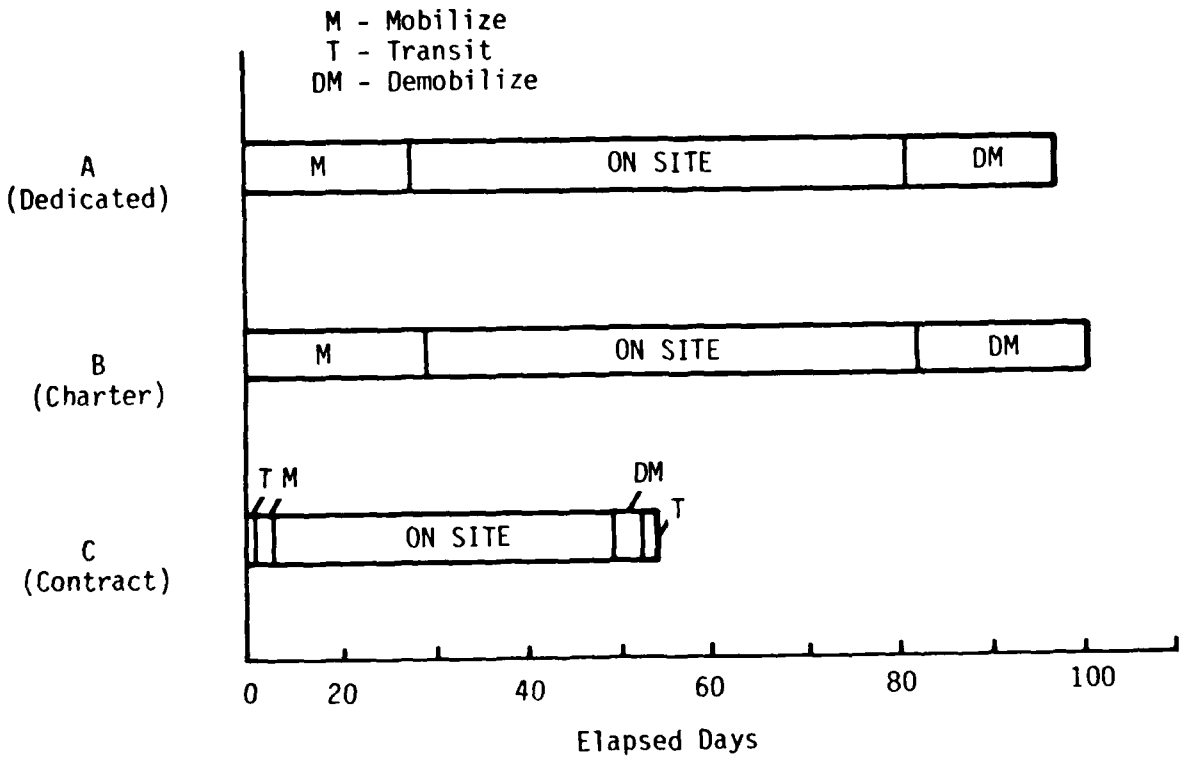

Figure 6. Performance Schedule - Scenario 3

USER/LOCATION \ YEARS	PROJECT TYPE* - DURATION IN DAYS 1	2	3	4	5	PRIMARY TASKS**
PMTC HAWAII		#1 - 142 days				A, B, C & D
PMTC HAWAII					#1 - 50 days	C, D, & E
NAVSEA SEATTLE				#1 - 92 days		A & C
NAVSEA HAWAII					#1 - 110 days	A & C
NAVAL FLEET TRAINING SAN DIEGO			#2 - 38 days			A & B
NOSC SAN DIEGO						A & B
CEL PORT HUENEME	#3 - 87 days #2 - 18 days	#2 - 18 days	#2 - 87 days	#2 - 33 days		A, B, C & F
TOTAL NO. DAYS	105	160	125	125	160	675/5 = 135

*Project Type No. 1 - Scenario 1 - U/W Range Installation, Upgrade and Maintenance
2 - Scenario 2 - Mooring, Test Bed Installations, Other
3 - Scenario 3 - Array Development Installations

**Primary Tasks
A - Implantment with Accuracy - Large, Heavy Objects
B - Recovery/Deployment of Large Heavy Objects, Deep Water
C - Cable Laying/Stabilization
D - Cable Landings
E - Cable Retrieval and Splice
F - Cable Trenching

Figure 7. Project Execution Schedule - Alternative A - 135 Days/Year

USER/LOCATION \ YEARS	PROJECT TYPE* - DURATION IN DAYS 1	2	3	4	5	PRIMARY TASKS**
PMTC HAWAII		#1 - 142 days				A, B, C & D
PMTC HAWAII						C, D, & E
NAVSEA SEATTLE				#1 - 92 days		A & C
NAVSEA HAWAII						A & C
NAVAL FLEET TRAINING SAN DIEGO			#2 - 38 days			A & B
NOSC SAN DIEGO						A & B
CEL PORT HUENEME	#3 - 87 days		#2 - 8 days		#2 - 83 days	A, B, C & F
TOTAL NO. DAYS	87	142	46	92	83	450/5 = 90

*Project Type No. 1 - Scenario 1 - U/W Range Installation, Upgrade and Maintenance
2 - Scenario 2 - Mooring, Test Bed Installations, Other
3 - Scenario 3 - Array Development Installations

**Primary Tasks
A - Implantment with Accuracy - Large, Heavy Objects
B - Recovery/Deployment of Large Heavy Objects, Deep Water
C - Cable Laying/Stabilization
D - Cable Landings
E - Cable Retrieval and Splice
F - Cable Trenching

Figure 8. Project Execution Schedule - Alternative A - 90 Days/Year

USER/LOCATION \ YEARS	PROJECT TYPE* - DURATION IN DAYS 1	2	3	4	5	PRIMARY TASKS**
PMTC HAWAII		#1 - 142 days				A, B, C & D
PMTC HAWAII					#1 - 50 days	C, D, & E
NAVSEA SEATTLE				#1 - 92 days		A & C
NAVSEA HAWAII					#1 - 110 days	A & C
NAVAL FLEET TRAINING SAN DIEGO			#2 - 38 days			A & B
NOSC SAN DIEGO	#2 - 75 days		#2 - 55 days			A & B
CEL PORT HUENEME	#3 - 87 days #2 - 18 days	#2 - 38 days	#2 - 87 days	#2 - 88 days	#2 - 20 days	A, B, C & F
TOTAL NO. DAYS	180	180	180	180	180	900/5 - 180

*Project Type No. 1 - Scenario 1 - U/W Range Installation, Upgrade and Maintenance
2 - Scenario 2 - Mooring, Test Bed Installations, Other
3 - Scenario 3 - Array Development Installations

**Primary Tasks
A - Implantment with Accuracy - Large, Heavy Objects
B - Recovery/Deployment of Large Heavy Objects, Deep Water
C - Cable Laying/Stabilization
D - Cable Landings
E - Cable Retrieval and Splice
F - Cable Trenching

Figure 9. Project Execution Schedule - Alternative A - 180 Days/Year

USER/LOCATION \ YEARS	PROJECT TYPE* - DURATION IN DAYS 1	2	3	4	5	PRIMARY TASKS**
PMTC HAWAII		#1 - 135 days				A, B, C & D
PMTC HAWAII					#1 - 44 days	C, D, & E
NAVSEA SEATTLE				#1 - 92 days		A & C
NAVSEA HAWAII					#1 - 104 days	A & C
NAVAL FLEET TRAINING SAN DIEGO			#2 - 43 days			A & B
NOSC SAN DIEGO						A & B
CEL PORT HUENEME	#3 - 90 days #2 - 18 days	#2 - 18 days	#2 - 87 days	#2 - 33 days		A, B, C & F
TOTAL NO. DAYS	108	153	130	125	148	664/5 = 133

*Project Type No. 1 - Scenario 1 - U/W Range Installation, Upgrade and Maintenance
2 - Scenario 2 - Mooring, Test Bed Installations, Other
3 - Scenario 3 - Array Development Installations

**Primary Tasks
A - Implantment with Accuracy - Large, Heavy Objects
B - Recovery/Deployment of Large Heavy Objects, Deep Water
C - Cable Laying/Stabilization
D - Cable Landings
E - Cable Retrieval and Splice
F - Cable Trenching

Figure 10. Project Execution Schedule - Alternative B - 135 Days/Year

USER/LOCATION \ YEARS	PROJECT TYPE* - DURATION IN DAYS 1	2	3	4	5	PRIMARY TASKS**
PMTC HAWAII		#1 - 135 days				A, B, C & D
PMTC HAWAII						C, D, & E
NAVSEA SEATTLE				#1 - 92 days		A & C
NAVSEA HAWAII						A & C
NAVAL FLEET TRAINING SAN DIEGO			#2 - 43 days			A & B
NOSC SAN DIEGO						A & B
CEL PORT HUENEME	#3 - 90 days		#2 - 8 days		#2 - 83 days	A, B, C & F
TOTAL NO. DAYS	90	135	51	92	83	451/5 = 90

*Project Type No. 1 - Scenario 1 - U/W Range Installation, Upgrade and Maintenance
2 - Scenario 2 - Mooring, Test Bed Installations, Other
3 - Scenario 3 - Array Development Installations

**Primary Tasks A - Implantment with Accuracy - Large, Heavy Objects
B - Recovery/Deployment of Large Heavy Objects, Deep Water
C - Cable Laying/Stabilization
D - Cable Landings
E - Cable Retrieval and Splice
F - Cable Trenching

Figure 11. Project Execution Schedule - Alternative B - 90 Days/Year

USER/LOCATION \ YEARS	PROJECT TYPE* - DURATION IN DAYS 1	2	3	4	5	PRIMARY TASKS**
PMTC HAWAII		#1 - 135 days				A, B, C & D
PMTC HAWAII					#1 - 44 days	C, D, & E
NAVSEA SEATTLE				#1 - 92 days		A & C
NAVSEA HAWAII					#1 - 104 days	A & C
NAVAL FLEET TRAINING SAN DIEGO			#2 - 43 days			A & B
NOSC SAN DIEGO	#2 - 75 days		#2 - 55 days			A & B
CEL PORT HUENEME	#3 - 90 days #2 - 18 days	#2 - 38 days	#2 - 87 days	#2 - 88 days	#2 - 20 days	A, B, C & F
TOTAL NO. DAYS	183	173	185	180	168	889/5 = 178

*Project Type No. 1 - Scenario 1 - U/W Range Installation, Upgrade and Maintenance
2 - Scenario 2 - Mooring, Test Bed Installations, Other
3 - Scenario 3 - Array Development Installations

**Primary Tasks
A - Implantment with Accuracy - Large, Heavy Objects
B - Recovery/Deployment of Large Heavy Objects, Deep Water
C - Cable Laying/Stabilization
D - Cable Landings
E - Cable Retrieval and Splice
F - Cable Trenching

Figure 12. Project Execution Schedule - Alternative B - 180 Days/Year

USER/LOCATION \ YEARS	PROJECT TYPE* - DURATION IN DAYS 1	2	3	4	5	PRIMARY TASKS**
PMTC HAWAII		#1 - 95 days				A, B, C & D
PMTC HAWAII					#1 - 34 days	C, D, & E
NAVSEA SEATTLE				#1 - 62 days		A & C
NAVSEA HAWAII					#1 - 74 days	A & C
NAVAL FLEET TRAINING SAN DIEGO			#2 - 20 days			A & B
NOSC SAN DIEGO						A & B
CEL PORT HUENEME	#3 - 44 days #2 - 18 days	#2 - 18 days	#2 - 87 days	#2 - 33 days		A, B, C & F
TOTAL NO. DAYS	62	113	107	95	108	485/5 = 97

*Project Type No. 1 - Scenario 1 - U/W Range Installation, Upgrade and Maintenance
2 - Scenario 2 - Mooring, Test Bed Installations, Other
3 - Scenario 3 - Array Development Installations

**Primary Tasks A - Implantment with Accuracy - Large, Heavy Objects
B - Recovery/Deployment of Large Heavy Objects, Deep Water
C - Cable Laying/Stabilization
D - Cable Landings
E - Cable Retrieval and Splice
F - Cable Trenching

Figure 13. Project Execution Schedule - Alternative C - 135 Days/Year

USER/LOCATION \ YEARS	PROJECT TYPE* - DURATION IN DAYS 1	2	3	4	5	PRIMARY TASKS**
PMTC HAWAII		#1 - 95 days				A, B, C & D
PMTC HAWAII						C, D, & E
NAVSEA SEATTLE				#1 - 62 days		A & C
NAVSEA HAWAII						A & C
NAVAL FLEET TRAINING SAN DIEGO			#2 - 20 days			A & B
NOSC SAN DIEGO						A & B
CEL PORT HUENEME	#3 - 44 days		#2 - 8 days		#2 - 83 days	A, B, C & F
TOTAL NO. DAYS	44	95	28	62	83	312/5 = 62

*Project Type No. 1 - Scenario 1 - U/W Range Installation, Upgrade and Maintenance
2 - Scenario 2 - Mooring, Test Bed Installations, Other
3 - Scenario 3 - Array Development Installations

**Primary Tasks
A - Implantment with Accuracy - Large, Heavy Objects
B - Recovery/Deployment of Large Heavy Objects, Deep Water
C - Cable Laying/Stabilization
D - Cable Landings
E - Cable Retrieval and Splice
F - Cable Trenching

Figure 14. Project Execution Schedule - Alternative C - 90 Days/Year

USER/LOCATION \ YEARS	PROJECT TYPE* - DURATION IN DAYS 1	2	3	4	5	PRIMARY TASKS**
PMTC HAWAII		#1 - 95 days				A, B, C & D
PMTC HAWAII					#1 - 50 days	C, D, & E
NAVSEA SEATTLE				#1 - 62 days		A & C
NAVSEA HAWAII					#1 - 74 days	A & C
NAVAL FLEET TRAINING SAN DIEGO			#2 - 20 days			A & B
NOSC SAN DIEGO	#2 - 75 days		#2 - 55 days			A & B
CEL PORT HUENEME	#3 - 44 days #2 - 18 days	#2 - 38 days	#2 - 87 days	#2 - 88 days	#2 - 20 days	A, B, C & F
TOTAL NO. DAYS	137	133	162	150	144	726/5 = 145

*Project Type No. 1 - Scenario 1 - U/W Range Installation, Upgrade and Maintenance
2 - Scenario 2 - Mooring, Test Bed Installations, Other
3 - Scenario 3 - Array Development Installations

**Primary Tasks
A - Implantment with Accuracy - Large, Heavy Objects
B - Recovery/Deployment of Large Heavy Objects, Deep Water
C - Cable Laying/Stabilization
D - Cable Landings
E - Cable Retrieval and Splice
F - Cable Trenching

Figure 15. Project Execution Schedule - Alternative C - 180 Days/Year

4.0 LIFE CYCLE COSTS

Life cycle costs are made up of one-time and recurring costs. In the case of Alternative A (Dedicated), one-time costs include initial acquisition of the ocean construction platform and equipment replacements at some time during the 20-year economic life. Recurring costs include maintenance and operational. Maintenance costs for the platform are incurred every year for normal, routine maintenance and every three years for a major overhaul and drydocking. The operational costs vary yearly as a function of workload. There are three separate calculations of total life cycle costs corresponding to the 90, 135, and 180 day/year project execution schedules. The yearly amounts of recurring costs are variable over the total 20-year cycle. A terminal value for the platform is subtracted from the costs in the 20th year.

Alternative B (Charter) and C (Contract) have only yearly recurring costs over the 20-year economic life. These recurring costs are made up of operational and in-house labor required to prepare contracts, statements of work, tasking orders; to conduct negotiations; and to monitor performance. Ten percent of the operational costs was considered to be a conservative estimate of the yearly in-house support charges. In reality, previous cost history indicates that these support charges should be on the order of 12 to 15 percent. For the analysis, ten percent was a convenient number and greatly expedited the numerous calculations to be made. As dis- cussed previously with Alternative A, the operational costs of Alternatives B and C vary as a function of the workload. Again for both Alternatives B and C, three sets of calculations were made corresponding to the 90, 135, and 180 days per year project execution schedules. Cash flow diagrams representative of each alternative are shown in Figure 16. The following paragraphs discuss life cycle costs in terms of the present 1978 dollars, escalated dollars and net present value.

4.1 Constant 1978 Dollars

In accordance with the instructions set forth in Reference 3, all estimates of the life cycle costs are first made in terms of constant dollars

Referring to the cash flow diagram of Alternative A, the first cost that occurs is the acquisition or initial investment cost. This cost ranges from $6.2 million to $9.5 million depending upon the design of the platform as documented in the Preliminary Design Study, Reference 11. Recurring maintenance costs are $132,103 annually and $225,000 every three years for drydocking and major overhaul of the platform. Refurbishment or replacement of major equipment on the platform is estimated to cost $100,000 during each of the sixth, seventh, eighth, and ninth years of economic life. These recurring maintenance charges have been estimated based upon the Ocean Engineering and Construction Project Office's experience to date with the SEACON, the existing ocean construction platform operational on the East Coast since September 1976. The breakdown of maintenance costs are detailed in Reference 12. The above costs, acquisition and maintenance, do not apply to Alternatives B and c. Since the yearly operational costs are a function of the number of project execution days, the estimating procedure requires several steps of calculations. The basis for estimating operational costs is the work performed by Global Marine Development, Inc. reported in the West Coast Ocean Construction Platform Preliminary Design Study (Reference 11). Total costs associated with three scenarios as performed by the three alternatives were found to be as follows:

Scenario	1	2	3
Alternative			
A (Dedicated)	$ 421,607	$ 85,199	$ 268,687
B (Charter)	1,415,393	288,915	1,065,470
C (Contract)	1,625,533	342,036	793,590

The breakdown of these operational costs into various categories is shown

for each scenario in Figures 17, 18, and 19. The costs per mission day (or day rates) are useful to the analysis and summarized below:

Scenario	1	2	3
Alternative			
A (Dedicated)	$ 2,969/day	$ 2,242/day	$ 3,088/day
B (Charter)	10,484	6,719	11,838
C (Contract)	17,111	17,102	18,036

The next step in the analysis was to apply the estimated scenario costs to the project execution schedules. Within each five-year schedule, calculations for each one of the three scenarios was perfromed. The schedules were completed by performing the additional required number of days at the appropriate day rate.

The annual costs of project execution (operational) are tabulated in Figures 20, 21, and 22 for Alternatives A, B and C respectively. The costs have been estimated for five years with 90, 135 and 180 days per year average workload over the five years. The five-year operational costs are repeated four times to cover the 20-year economic life.

To arrive at the total life cycle costs, the one time and recurring costs are combined. These costs are itemized year by year in 1978 dollars and are presented for all cases of the analysis in Figures 23 through 31. The total costs in constant 1978 dollars are summarized below:

	90	135	180
A (Dedicated)	$18.26M	$20.74M	$22.76M
B (Charter)	19.12	27.87	34.52
C (Contract)	23.66	36.69	54.82

4.2 Current (Escalated) Dollars

As discussed in Reference 1, the use of current dollars in the analysis has certain advantages for use in budget and programming documents. A primary use of escalating the costs in this analysis was to develop cost estimates which reflected the most likely level of expenditure. A secondary use was to have a realistic dollar value of Alternative A's platform acquisition cost for entry into the POM. It was also desirable to anticipate the actual costs of program support in any one year or set of years for all of the alternatives, especially the status quo situation.

The procedure used here was to first take the 1978 dollar costs and escalate them to the beginning year of the economic analysis (1982). Based upon consumer price index data from Reference 8, escalation rates as used in the Energy Conservation Investment Program (Reference 7) and guidance from Global Marine (Reference 11) as to escalation rates used in the ocean engineering community, a uniform inflation rate of 8 per cent was used in the calculations.

Acquisition costs of Alternative A would be incurred in 1981 and therefore only escalated to that year. The calculations of total life cycle costs in "Current Dollars" are shown year by year for the 20-year life in Figures 32, 33 and 34. The totals for each alternative are as follows:

Average Project Execution Days/Year	90	135	180
A (Dedicated)	$39.74M	$48.65M	$55.26M
B (Charter)	62.23	94.17	115.96
C (Contract)	80.38	124.63	184.76

4.3 Net Present Value

The third method of comparing the three alternatives in this analysis was to calculate the net present value (NPV) of the life cycle costs. The discount rate of 10 percent as prescribed by DoD Instruction 7041.3 was used in the

calculations. In addition, the net present values were determined for the three differential inflation rates of 0, 4 and 8 percent. The combined discount/inflation factors were taken from pages 7, 11 and 15 of Appendix E of Reference 5. The data are presented here in Figures 35 through 43. The net present values as a function of the average workload per year were found to be the following:

Differential Inflation Rate = 0%	90	135	180
A (Dedicated)	$17.45M	$18.84M	$20.11M
B (Charter)	11.99	16.85	21.02
C (Contract	14.22	21.97	32.60

Differential Inflation Rate = 4%	90	135	180
A (Dedicated)	$19.32M	$21.29M	$22.93
B (Charter)	15.93	22.72	28.26
C (Contract)	19.35	29.75	44.73

Differential Inflation Rate = 8%	90	135	180
A (Dedicated)	$22.08M	$24.86M	$27.17M
B (Charter)	21.92	31.71	39.33
C (Contract)	26.89	41.67	62.38

The effect of inflation on net present value is shown in Figures 44, 45 and 46 where the data are plotted as a function of execution days for the three rates of 0, 4 and 8 percent.

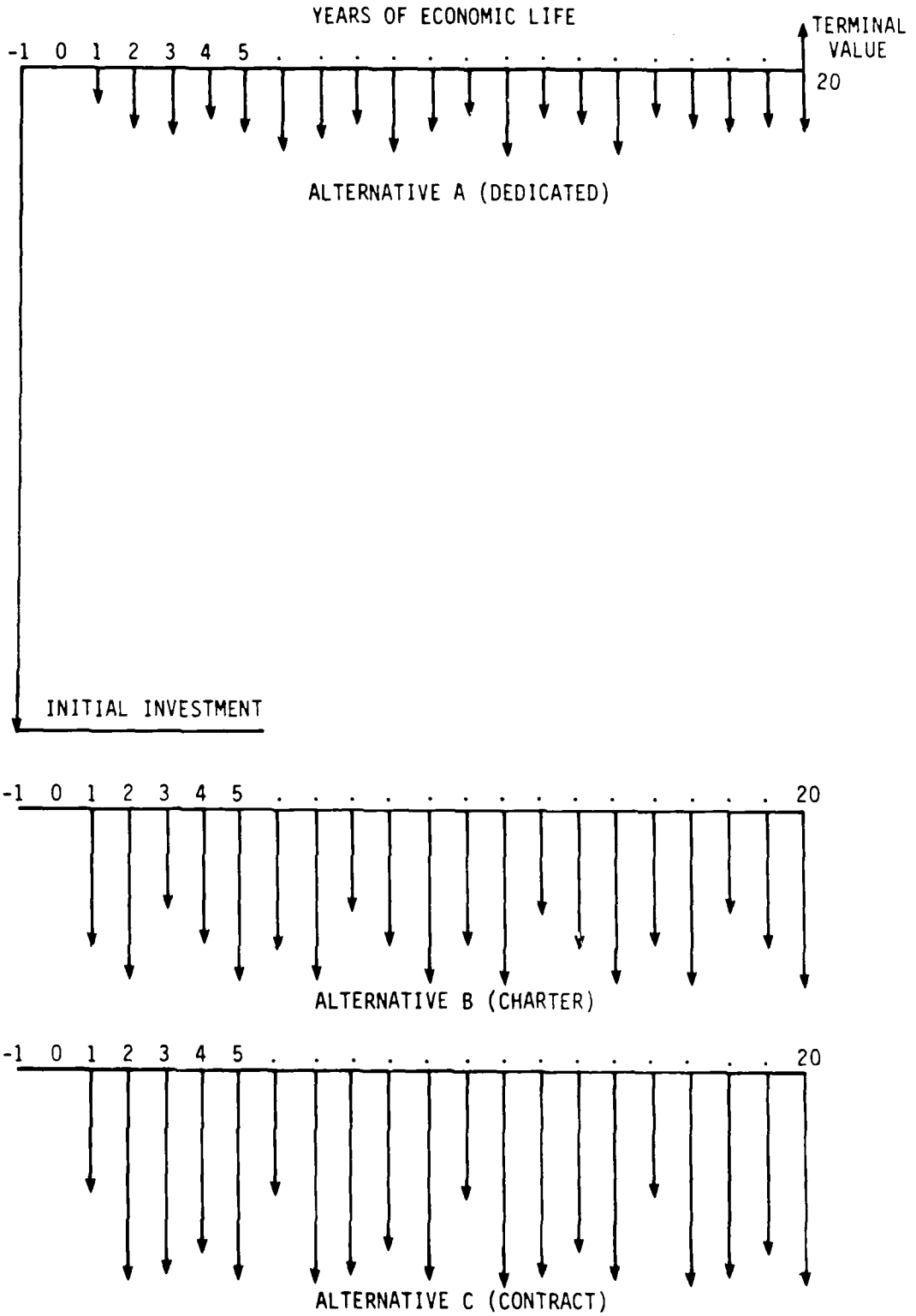

Figure 16. Cash Flow Diagrams

MISSION TYPE: ST. CROIX

	ALTERNATIVES A	B	C
TOTAL FY 78	$421,607	$1,415,393	$1,625,533
MISSION DAYS	142	135	95
COST PER MISSION DAY	$2,969	$10,484	$17,111
PROVISIONS (NO. OF PEOPLE)	$29,852 (47)	$33,660 (50)	$28,603 (36)
CONSUMABLES (FUEL, OIL, OTHER)	$77,861	$168,118	$62,660
TRAVEL/PER DIEM	$43,461	$40,221	$2,075
SUB TOTAL	$151,174	$241,999	$93,338
MOBILIZATION AND DE-MOBILIZATION	$5,175	$159,808	0
G&A AND FEE	0	$238,667	$281,757
LEASE CHARGES	0	$774,919	$470,725
CREW PAYROLL	$265,258	(Crew payroll included in lease charges)	$779,713
TOTAL	$421,607	$1,415,393	$1,625,533

Figure 17. Project Operational Cost Comparisons - Scenario 1

MISSION TYPE: SQUAW MOORING

	ALTERNATIVES A	B	C
TOTAL FY 78	$85,199	$288,915	$342,036
MISSION DAYS	38	43	20
COST PER MISSION DAY	$2,242	$3,719	$17,102
PROVISIONS (NO. OF PEOPLE)	$6,069 (27)	$5,270 (20)	$6,103 (36)
CONSUMABLES (FUEL, OIL, OTHER)	$17,877	$33,887	$12,734
TRAVEL/PER DIEM	$9,897	$8,169	$710
SUB TOTAL	$33,843	$47,326	$19,547
MOBILIZATION AND DE-MOBILIZATION	$1,956	$27,865	0
G&A AND FEE	0	$48,724	$59,239
LEASE CHARGES	0	$165,000	$99,100
CREW PAYROLL	$49,400	(Crew payroll included in lease charges)	$164,150
TOTAL	$85,199	$288,915	$342,036

Figure 18. Project Operational Cost Comparisons - Scenario 2

MISSION TYPE: CEL - SEACON II TYPE

	ALTERNATIVES A	B	C
TOTAL FY 78	$268,687	$1,065,470	$793,590
MISSION DAYS	87	90	44
COST PER MISSION DAY	$3,088	$11,838	$18,036
PROVISIONS (NO. OF PEOPLE)	$21,582 (47)	$18,530 (40)	$13,405 (36)
CONSUMABLES (FUEL, OIL, OTHER)	$61,128	$87,060	$42,876
TRAVEL/PER DIEM	$32,082	$25,600	$761
SUB TOTAL	$114,792	$131,190	$57,042
MOBILIZATION AND DE-MOBILIZATION	$4,255	$263,788	0
G&A AND FEE	0	$180,474	$137,598
LEASE CHARGES	0	$490,018	$237,820
CREW PAYROLL	$149,640	(Crew payroll included in lease charges)	$361,130
TOTAL	$268,687	$1,065,470	$793,590

Figure 19. Project Operational Cost Comparisons - Scenario 3

YEAR	PROJECT EXECUTION LEVEL - AVERAGE NUMBER OF DAYS/YEAR								
	90			135			180		
	SCENARIO TYPE	ADDITIONAL DAYS	OPERATIONAL COSTS	SCENARIO TYPE	ADDITIONAL DAYS	OPERATIONAL COSTS	SCENARIO TYPE	ADDITIONAL DAYS	OPERATIONAL COSTS
1	NO.3	-	$268,687	NO.3	-	$268,687	NO.2	75	$168,150
				NO.2	18	40,356	NO.3	-	268,687
							NO.2	18	40,356
2	NO.1	-	$421,607	NO.1	-	$421,607	NO.1	-	$421,607
				NO.2	18	40,356	NO.2	38	85,199
3	NO.2	-	$85,199	NO.2	-	$85,199	NO.2	55	$123,310
	NO.2	8	17,936	NO.2	87	195,054	NO.2	-	85,199
							NO.2	87	195,054
4	NO.1	92	$273,148	NO.1	92	$273,148	NO.1	92	$273,148
				NO.2	33	73,986	NO.2	88	197,296
5	NO.2	83	$186,086	NO.1	110	$326,590	NO.2	20	$44,840
				NO.1	50	148,450	NO.1	110	326,590
							NO.1	50	148,450

Figure 20. Operational Costs, Alternative A (Dedicated)

YEAR	PROJECT EXECUTION LEVEL - AVERAGE NUMBER OF DAYS/YEAR								
	90			135			180		
	SCENARIO TYPE	ADDITIONAL DAYS	OPERATIONAL COSTS	SCENARIO TYPE	ADDITIONAL DAYS	OPERATIONAL COSTS	SCENARIO TYPE	ADDITIONAL DAYS	OPERATIONAL COSTS
1	NO.3	-	$1,065,470	NO.3	-	$1,065,475	NO.2	75	$ 503,925
				NO.2	18	120,942	NO.3	-	1,065,470
							NO.2	18	120,942
2	NO.1	-	$1,415,393	NO.1	-	$1,415,393	NO.1	-	$1,415,393
				NO.2	18	120,942	NO.2	38	255,322
3	NO.2	-	$288,915	NO.2	-	$288,915	NO.2	55	$369,545
	NO.2	8	53,752	NO.2	87	584,553	NO.2	-	288,915
							NO.2	87	584,553
4	NO.1	92	$964,528	NO.1	92	$964,528	NO.1	92	$964,528
				NO.2	33	221,727	NO.2	88	591,272
5	NO.2	83	$557,677	NO.1	104	$1,090,336	NO.2	20	$ 134,380
				NO.1	44	461,296	NO.1	104	1,090,336
							NO.1	44	461,296

Figure 21. Operational Costs, Alternative B (Charter)

YEAR	PROJECT EXECUTION LEVEL - AVERAGE NUMBER OF DAYS/YEAR								
	90			135			180		
	SCENARIO TYPE	ADDITIONAL DAYS	OPERATIONAL COSTS	SCENARIO TYPE	ADDITIONAL DAYS	OPERATIONAL COSTS	SCENARIO TYPE	ADDITIONAL DAYS	OPERATIONAL COSTS
1	NO.3	-	$793,590	NO.3	-	$793,590	NO.2	75	$1,282,650
				NO.2	18	307,836	NO.3	-	793,590
							NO.2	18	307,836
2	NO.1	-	$1,625,533	NO.1	-	$1,625,533	NO.1	-	$1,625,533
				NO.2	18	307,836	NO.2	38	649,876
3	NO.2	-	$342,036	NO.2	-	$ 342,036	NO.2	55	$ 940,610
	NO.2	8	136,816	NO.2	87	1,487,874	NO.2	-	342,036
							NO.2	87	1,487,874
4	NO.1	62	$1,060,882	NO.1	62	$1,060,882	NO.1	62	$1,060,882
				NO.2	33	564,366	NO.2	88	1,504,976
5	NO.2	83	$1,419,466	NO.1	34	$ 581,774	NO.2	20	$ 342,036
				NO.1	74	1,266,214	NO.1	74	1,266,214
							NO.1	50	855,550

Figure 22. Operational Costs, Alternative C (Contract)

PROJECT YEAR	ONE TIME	RECURRING			
	ACQUISITION OR EQUIPMENT REPLACEMENT	MAINTENANCE		OPERATIONAL (VARIES WITH WORKLOAD)	TOTAL
		ANNUAL	TRI-ANNUAL		
1981 (-1)	$9,460,000				
1982 (0)					
1983 (1)				$ 268,687	
(2)		$ 132,103		421,607	
(3)		132,103	$ 225,000	103,135	
(4)		132,103		273,148	
(5)		132,103		186,086	
(6)	100,000	132,103	225,000	268,687	
(7)	100,000	132,103		421,607	
(8)	100,000	132,103		103,135	
(9)	100,000	132,103	225,000	273,148	
(10)		132,103		186,086	
(11)		132,103		268,687	
(12)		132,103	225,000	421,607	
(13)		132,103		103,135	
(14)		132,103		273,148	
(15)		132,103	225,000	186,086	
(16)		132,103		268,687	
(17)		132,103		421,607	
(18)		132,103	225,000	103,135	
(19)		132,103		273,148	
2002 (20)		0		186,086	
Net Terminal Value	($473,000)				
Totals	$9,387,000	$2,509,957	$1,350,000	$ 5,010,652	
			GRAND TOTAL	$18,257,609	

Figure 23. Project Costs, 1978 Dollars - Alternative A - 90 Days/Year

PROJECT YEAR	ONE TIME	RECURRING			
	ACQUISITION OR EQUIPMENT REPLACEMENT	MAINTENANCE		OPERATIONAL (VARIES WITH WORKLOAD)	TOTAL
		ANNUAL	TRI-ANNUAL		
1981 (-1)	$9,460,000				
1982 (0)					
1983 (1)				$ 309,043	
(2)		$ 132,103		461,963	
(3)		132,103	$ 225,000	280,253	
(4)		132,103		347,134	
(5)		132,103		475,040	
(6)	100,000	132,103	225,000	309,043	
(7)	100,000	132,103		461,963	
(8)	100,000	132,103		280,253	
(9)	100,000	132,103	225,000	347,134	
(10)		132,103		475,040	
(11)		132,103		309,043	
(12)		132,103	225,000	461,963	
(13)		132,103		280,253	
(14)		132,103		347,134	
(15)		132,103	225,000	475,040	
(16)		132,103		309,043	
(17)		132,103		461,963	
(18)		132,103	225,000	280,253	
(19)		132,103		347,134	
2002 (20)		0		475,040	
Net Terminal Value	($473,000)				
Totals	$9,387,000	$2,509,957	$1,350,000	$ 7,493,732	
			GRAND TOTAL	$20,740,689	

Figure 24. Project Costs, 1978 Dollars - Alternative A - 135 Days/Year

PROJECT YEAR	ONE TIME	RECURRING			
	ACQUISITION OR EQUIPMENT REPLACEMENT	MAINTENANCE		OPERATIONAL (VARIES WITH WORKLOAD)	TOTAL
		ANNUAL	TRI-ANNUAL		
1981 (-1)	$9,460,000				
1982 (0)					
1983 (1)				$ 477,193	
(2)		$ 132,103		506,806	
(3)		132,103	$ 225,000	403,563	
(4)		132,103		470,444	
(5)		132,103		519,880	
(6)	100,000	132,103	225,000	477,193	
(7)	100,000	132,103		506,806	
(8)	100,000	132,103		403,563	
(9)	100,000	132,103	225,000	470,444	
(10)		132,103		519,880	
(11)		132,103		477,193	
(12)		132,103	225,000	506,806	
(13)		132,103		403,563	
(14)		132,103		470,444	
(15)		132,103	225,000	519,880	
(16)		132,103		477,193	
(17)		132,103		506,806	
(18)		132,103	225,000	403,563	
(19)		132,103		470,444	
2002 (20)		0		519,880	
Net Terminal Value	($473,000)				
Totals	$9,387,000	$2,509,957	$1,350,000	$ 9,511,544	
			GRAND TOTAL	$22,758,501	

Figure 25. Project Costs, 1978 Dollars - Alternative A - 180 Days/Year

PROJECT YEAR	ONE TIME	RECURRING			
	ACQUISITION OR EQUIPMENT REPLACEMENT	MAINTENANCE		OPERATIONAL (VARIES WITH WORKLOAD)	TOTAL
		ANNUAL	TRI-ANNUAL		
1981 (-1)					
1982 (0)					
1983 (1)	$106,547			$ 1,065,470	
(2)	141,539			1,415,393	
(3)	34,267			342,667	
(4)	96,453			964,528	
(5)	55,768			557,677	
(6)	106,547			1,065,470	
(7)	141,539			1,415,393	
(8)	34,267			342,667	
(9)	96,453			964,528	
(10)	55,768			557,677	
(11)	106,547			1,065,470	
(12)	141,539			1,415,393	
(13)	34,267			342,667	
(14)	96,453			964,528	
(15)	55,768			557,677	
(16)	106,547			1,065,470	
(17)	141,539			1,415,393	
(18)	34,267			342,667	
(19)	96,453			964,528	
2002 (20)	55,768			557,677	
Net Terminal Value	0				
Totals	$1,738,293			$17,382,940	
			GRAND TOTAL	$19,121,233	

Figure 26. Project Costs, 1978 Dollars - Alternative B - 90 Days/Year

PROJECT YEAR	ONE TIME	RECURRING			
	ACQUISITION OR EQUIPMENT REPLACEMENT	MAINTENANCE		OPERATIONAL (VARIES WITH WORKLOAD)	TOTAL
		ANNUAL	TRI-ANNUAL		
1981 (-1)					
1982 (0)					
1983 (1)	118,642			1,186,417	
(2)	153,634			1,536,335	
(3)	87,347			873,468	
(4)	118,626			1,186,255	
(5)	155,163			1,551,632	
(6)	118,642			1,186,417	
(7)	153,634			1,536,335	
(8)	87,347			873,468	
(9)	118,626			1,186,255	
(10)	155,163			1,551,632	
(11)	118,642			1,186,417	
(12)	153,634			1,536,335	
(13)	87,347			873,468	
(14)	118,626			1,186,255	
(15)	155,163			1,551,632	
(16)	118,642			1,186,417	
(17)	153,634			1,536,335	
(18)	87,347			873,468	
(19)	118,626			1,186,255	
2002 (20)	155,163			1,551,632	
Net Terminal Value	0				
Totals	$2,533,643			$25,336,428	
			GRAND TOTAL	$27,870,071	

Figure 27. Project Costs, 1978 Dollars - Alternative B - 135 Days/Year

PROJECT YEAR	ONE TIME	RECURRING			
	ACQUISITION OR EQUIPMENT REPLACEMENT	MAINTENANCE		OPERATIONAL (VARIES WITH WORKLOAD)	TOTAL
		ANNUAL	TRI-ANNUAL		
1981 (-1)					
1982 (0)					
1983 (1)	$169,034			$1,690,337	
(2)	167,072			1,670,715	
(3)	124,301			1,243,013	
(4)	155,580			1,555,800	
(5)	168,601			1,686,012	
(6)	169,034			1,690,337	
(7)	167,072			1,670,715	
(8)	124,301			1,243,013	
(9)	155,580			1,555,800	
(10)	168,601			1,686,012	
(11)	169,034			1,690,337	
(12)	167,072			1,670,715	
(13)	124,301			1,243,013	
(14)	155,580			1,555,800	
(15)	168,601			1,686,012	
(16)	169,034			1,690,337	
(17)	167,072			1,670,715	
(18)	124,301			1,243,013	
(19)	155,580			1,555,800	
2002 (20)	168,601			1,686,012	
Net Terminal Value					
Totals	$3,138,351			$31,383,508	
			GRAND TOTAL	$34,521,859	

Figure 28. Project Costs, 1978 Dollars - Alternative B - 180 Days/Year

PROJECT YEAR	ONE TIME	RECURRING			
	ACQUISITION OR EQUIPMENT REPLACEMENT	MAINTENANCE		OPERATIONAL (VARIES WITH WORKLOAD)	TOTAL
		ANNUAL	TRI-ANNUAL		
1981 (-1)					
1982 (0)					
1983 (1)	79,359			793,590	
(2)	162,553			1,625,533	
(3)	47,885			478,852	
(4)	106,088			1,060,882	
(5)	141,947			1,419,466	
(6)	79,359			793,590	
(7)	162,553			1,625,533	
(8)	47,885			478,852	
(9)	106,088			1,060,882	
(10)	141,947			1,419,466	
(11)	79,359			793,590	
(12)	162,553			1,625,533	
(13)	47,885			478,852	
(14)	106,088			1,060,882	
(15)	141,947			1,419,466	
(16)	79,359			793,590	
(17)	162,553			1,625,533	
(18)	47,885			478,852	
(19)	106,088			1,060,882	
2002 (20)	141,947			1,419,466	
Net Terminal Value	0				
Totals	$2,151,329			$21,513,292	
			GRAND TOTAL	$23,664,621	

Figure 29. Project Costs, 1978 Dollars - Alternative C - 90 Days/Year

PROJECT YEAR	ONE TIME	RECURRING			
	ACQUISITION OR EQUIPMENT REPLACEMENT	MAINTENANCE		OPERATIONAL (VARIES WITH WORKLOAD)	TOTAL
		ANNUAL	TRI-ANNUAL		
1981 (-1)					
1982 (0)					
1983 (1)	110,143			1,101,426	
(2)	193,337			1,933,369	
(3)	182,991			1,829,910	
(4)	162,525			1,625,248	
(5)	184,799			1,847,988	
(6)	110,143			1,101,426	
(7)	193,337			1,933,369	
(8)	182,991			1,829,910	
(9)	162,525			1,625,248	
(10)	184,799			1,847,988	
(11)	110,143			1,101,426	
(12)	193,337			1,933,369	
(13)	182,991			1,829,910	
(14)	162,525			1,625,248	
(15)	184,799			1,847,988	
(16)	110,143			1,101,426	
(17)	193,337			1,933,369	
(18)	182,991			1,829,910	
(19)	162,525			1,625,248	
2002 (20)	184,799			1,847,988	
Net Terminal Value					
Totals	$3,335,176			$33,351,764	
			GRAND TOTAL	$36,686,940	

Figure 30. Project Costs, 1978 Dollars - Alternative C - 135 Days/Year

PROJECT YEAR	ONE TIME	RECURRING			
	ACQUISITION OR EQUIPMENT REPLACEMENT	MAINTENANCE		OPERATIONAL (VARIES WITH WORKLOAD)	TOTAL
		ANNUAL	TRI-ANNUAL		
1981 (-1)					
1982 (0)					
1983 (1)	238,408			$2,384,076	
(2)	227,541			2,275,409	
(3)	277,052			2,770,520	
(4)	256,586			2,565,858	
(5)	246,380			2,463,800	
(6)	238,408			2,384,076	
(7)	227,541			2,275,409	
(8)	277,052			2,770,520	
(9)	256,586			2,565,858	
(10)	246,380			2,463,800	
(11)	238,408			2,384,076	
(12)	227,541			2,275,409	
(13)	277,052			2,770,520	
(14)	256,586			2,565,858	
(15)	246,380			2,463,800	
(16)	238,408			2,384,076	
(17)	227,541			2,275,409	
(18)	277,052			2,770,520	
(19)	256,586			2,565,858	
2002 (20)	246,380			2,463,800	
Net Terminal Value	0				
Totals	$4,983,865			$49,838,652	
			GRAND TOTAL	$54,822,517	

Figure 31. Project Costs, 1978 Dollars - Alternative C - 180 Days/Year

PROJECT YEAR	ESCALATION FACTOR	90 DAYS COSTS 1982$	90 DAYS COSTS ESCALATED	135 DAYS COSTS 1982$	135 DAYS COSTS ESCALATED	180 DAYS COSTS 1982$	180 DAYS COSTS ESCALATED
(1982) 0	8%	$11.92	$11.920	$11.920	$11.920	$11.920	$11.920
1	1.080	.366	.395	.420	.454	.649	.701
2	1.166	.753	.878	.808	.942	.869	1.013
3	1.259	.626	.788	.867	1.092	1.035	1.303
4	1.360	.551	.749	.652	.887	.820	1.115
5	1.469	.433	.636	.826	1.213	.887	1.303
6	1.587	.987	1.566	1.042	1.654	1.271	2.017
7	1.714	.889	1.524	.944	1.618	1.005	1.723
8	1.851	.456	.844	.697	1.290	.865	1.601
9	1.999	.993	1.985	1.094	2.187	1.262	2.523
10	2.159	.433	.935	.826	1.783	.887	1.915
11	2.332	.545	1.271	.600	1.399	.829	1.933
12	2.518	1.059	2.667	1.114	2.805	1.175	2.959
13	2.719	.320	.870	.561	1.525	.729	1.982
14	2.937	.551	1.618	.652	1.915	.820	2.408
15	3.172	.739	2.344	1.132	3.591	1.193	3.784
16	3.426	.545	1.867	.600	2.056	.829	2.840
17	3.700	.753	2.786	.808	2.990	.869	3.215
18	3.996	.626	2.501	.867	3.465	1.035	4.136
19	4.316	.551	2.378	.652	2.814	.820	3.539
20	4.661	.433	2.018	.826	3.850	.887	4.134
			42.540		51.450		58.060
	4.661	(.600)	(2.800)	(.600)	(2.800)	(.600)	(2.800)
TOTAL			$39.74M		$48.65M		$55.26M

Figure 32. Current Year Dollar Calculations - Alternative A

PROJECT YEAR	ESCALATION FACTOR	90 DAYS COSTS 1982$	90 DAYS COSTS ESCALATED	135 DAYS COSTS 1982$	135 DAYS COSTS ESCALATED	180 DAYS COSTS 1982$	180 DAYS COSTS ESCALATED
(1982) 0	8%						
1	1.080	1.595	1.723	1.776	1.918	2.530	2.732
2	1.166	2.118	2.470	2.299	2.681	2.500	2.915
3	1.259	.513	.646	1.307	1.646	1.860	2.342
4	1.360	1.443	1.962	1.775	2.414	2.328	3.166
5	1.469	.835	1.227	2.322	3.411	2.523	3.706
6	1.587	1.595	2.531	1.776	2.819	2.530	4.015
7	1.714	2.118	3.630	2.299	3.940	2.500	4.285
8	1.851	.513	.950	1.307	2.419	1.860	3.442
9	1.999	1.443	2.885	1.775	3.548	2.328	4.654
10	2.159	.835	1.803	2.322	5.013	2.523	5.447
11	2.332	1.595	3.720	1.776	4.142	2.530	5.900
12	2.518	2.118	5.333	2.299	5.789	2.500	6.295
13	2.719	.513	1.395	1.307	3.554	1.860	5.057
14	2.937	1.443	4.238	1.775	5.213	2.328	6.837
15	3.172	.835	2.649	2.322	7.365	2.523	8.003
16	3.426	1.595	5.464	1.776	6.085	2.530	8.668
17	3.700	2.118	7.837	2.299	8.506	2.500	9.250
18	3.996	.513	2.050	1.307	5.223	1.860	7.433
19	4.316	1.443	6.228	1.775	7.661	2.328	10.048
20	4.661	.835	3.892	2.322	10.823	2.523	11.760
TOTAL			$62.63M		$94.17M		$115.96M

Figure 33. Current Year Dollar Calculations - Alternative B

PROJECT YEAR	ESCALATION FACTOR	90 DAYS COSTS 1982$	90 DAYS COSTS ESCALATED	135 DAYS COSTS 1982$	135 DAYS COSTS ESCALATED	180 DAYS COSTS 1982$	180 DAYS COSTS ESCALATED
(1982) 0	8%						
1	1.080	1.188	1.283	1.648	1.780	3.567	3.852
2	1.166	2.433	2.837	2.893	3.373	3.405	3.970
3	1.259	.717	.903	2.738	3.447	4.145	5.219
4	1.360	1.588	2.160	2.432	3.308	3.840	5.222
5	1.469	2.124	3.120	2.766	4.063	3.687	5.416
6	1.587	1.188	1.885	1.648	2.615	3.567	5.661
7	1.714	2.433	4.170	2.893	4.959	3.405	5.836
8	1.851	.717	1.327	2.739	5.070	4.145	7.672
9	1.999	1.588	3.174	2.432	4.862	3.840	7.676
10	2.159	2.124	4.586	2.766	5.972	3.687	7.960
11	2.332	1.188	2.770	1.648	3.843	3.567	8.318
12	2.518	2.433	6.126	2.893	7.285	3.405	8.574
13	2.719	.717	1.950	2.739	7.447	4.145	11.270
14	2.937	1.588	4.664	2.432	7.143	3.840	11.278
15	3.172	2.124	6.737	2.766	8.774	3.687	11.695
16	3.426	1.188	4.070	1.648	5.646	3.567	12.221
17	3.700	2.433	9.002	2.893	10.704	3.405	12.599
18	3.996	.717	2.865	2.739	10.945	4.145	16.563
19	4.316	1.588	6.854	2.432	10.497	3.840	16.573
20	4.661	2.124	9.900	2.766	12.892	3.687	17.185
TOTAL			$80.38M		$124.63M		$184.76M

Figure 34. Current Year Dollar Calculations - Alternative C

		ALTERNATIVE A		ALTERNATIVE B		ALTERNATIVE C	
	DISCOUNT FACTOR	TOTAL COST	DISCOUNTED COST	TOTAL COST	DISCOUNTED COST	TOTAL COST	DISCOUNTED COST
-1	DIR = 0%	11.920	11.920	0		0	
0	DR = 10%						
1	.954	.366	.349	1.595	1.522	1.188	1.133
2	.867	.753	.653	2.118	1.836	2.433	2.109
3	.788	.626	.493	.513	.404	.717	.565
4	.717	.551	.395	1.443	1.035	1.588	1.139
5	.652	.433	.282	.835	.544	2.124	1.385
6	.592	.987	.584	1.595	.944	1.188	.703
7	.538	.889	.478	2.118	1.139	2.433	1.309
8	.489	.456	.223	.513	.251	.717	.351
9	.445	.993	.442	1.443	.642	1.588	.707
10	.405	.433	.175	.835	.338	2.124	.860
11	.368	.545	.201	1.595	.587	1.188	.437
12	.334	1.059	.354	2.118	.707	2.433	.813
13	.304	.320	.097	.513	.156	.717	.218
14	.276	.551	.152	1.443	.398	1.588	.438
15	.251	.739	.185	.835	.210	2.124	.533
16	.228	.545	.124	1.595	.364	1.188	.271
17	.208	.753	.157	2.118	.441	2.433	.506
18	.189	.626	.118	.513	.097	.717	.136
19	.172	.551	.095	1.443	.248	1.588	.273
20	.156	.433	.068	.835	.130	2.124	.331
TV	.156	(.600)					
TOTAL COST (DISCOUNTED)			$17.545		$11.993		$14.217
LESS TERMINAL VALUE (DISCOUNTED)			(.094) A		(0) B		(0) C
NET PRESENT VALUE			$17.451		$11.993		$14.217

Figure 35. Net Present Value Calculations, DIR = 0%, 90 Days/Year

		ALTERNATIVE A		ALTERNATIVE B		ALTERNATIVE C	
	DISCOUNT FACTOR	TOTAL COST	DISCOUNTED COST	TOTAL COST	DISCOUNTED COST	TOTAL COST	DISCOUNTED COST
-1	DIR = 0%	11.920	11.920				
0	DR = 10%						
1	.954	.420	.401	1.776	1.694	1.648	1.572
2	.867	.808	.701	2.299	1.993	2.893	2.508
3	.788	.867	.683	1.307	1.030	2.739	2.158
4	.717	.652	.467	1.775	1.273	2.432	1.744
5	.652	.826	.539	2.322	1.514	2.766	1.803
6	.592	1.042	.617	1.776	1.051	1.648	.976
7	.538	.944	.508	2.299	1.237	2.893	1.556
8	.489	.697	.341	1.307	.639	2.738	1.339
9	.445	1.094	.487	1.775	.790	2.432	1.082
10	.405	.826	.335	2.322	.940	2.766	1.120
11	.368	.600	.220	1.776	.654	1.648	.606
12	.334	1.114	.372	2.299	.768	2.893	.966
13	.304	.561	.171	1.307	.397	2.738	.832
14	.276	.652	.180	1.775	.490	2.432	.671
15	.251	1.132	.284	2.322	.582	2.766	.694
16	.228	.600	.137	1.776	.405	1.648	.376
17	.208	.808	.168	2.299	.478	2.893	.602
18	.189	.867	.164	1.307	.248	2.738	.518
19	.172	.652	.112	1.775	.305	2.432	.418
20	.156	.826	.129	2.322	.362	2.766	.431
TV	.156	(.600)		0		0	
TOTAL COST (DISCOUNTED)			$18.936		$16.850		$21.972
LESS TERMINAL VALUE (DISCOUNTED)			(.094) A		(0) B		(0) C
NET PRESENT VALUE			$18.842		$16.85		$21.97

Figure 36. Net Present Value Calculations, DIR = 0%, 135 Days/Year

		ALTERNATIVE A		ALTERNATIVE B		ALTERNATIVE C	
	DISCOUNT FACTOR	TOTAL COST	DISCOUNTED COST	TOTAL COST	DISCOUNTED COST	TOTAL COST	DISCOUNTED COST
-1	DIR = 0%	11.920		0		0	
0	DR = 10%						
1	.954	.649	.619	2.530	2.419	3.567	3.403
2	.867	.869	.753	2.500	2.168	3.405	2.952
3	.788	1.035	.816	1.860	1.466	4.145	2.683
4	.717	.820	.588	2.328	1.669	3.840	2.753
5	.652	.887	.578	2.523	1.645	3.687	2.404
6	.592	1.271	.752	2.530	1.498	3.567	2.112
7	.538	1.005	.541	2.500	1.345	3.405	1.832
8	.489	.865	.423	1.860	.909	4.145	2.027
9	.445	1.262	.562	2.328	1.036	3.840	1.709
10	.405	.887	.359	2.523	1.022	3.687	1.493
11	.368	.829	.305	2.530	.931	3.567	1.313
12	.334	1.175	.392	2.500	.835	3.405	1.137
13	.304	.729	.222	1.860	.565	4.145	1.260
14	.276	.820	.226	2.328	.643	3.840	1.060
15	.251	1.193	.299	2.523	.633	3.687	.925
16	.228	.829	.189	2.530	.577	3.567	.813
17	.208	.869	.181	2.500	.520	3.405	.708
18	.189	1.035	.196	1.860	.352	4.145	.783
19	.172	.820	.141	2.328	.400	3.840	.660
20	.156	.887	.138	2.523	.394	3.687	.575
	.156	(.600)					
TOTAL COST (DISCOUNTED)			$20.200		$21.022		$32.602
LESS TERMINAL VALUE (DISCOUNTED)			(.094) A		(0) B		(0) C
NET PRESENT VALUE			$20.106		$21.022		$32.602

Figure 37. Net Present Value Calculations DIR=0% - 180 Days/Year

		ALTERNATIVE A		ALTERNATIVE B		ALTERNATIVE C	
	DISCOUNT FACTOR	TOTAL COST	DISCOUNTED COST	TOTAL COST	DISCOUNTED COST	TOTAL COST	DISCOUNTED COST
-1	DIR = 4%	11.920	11.920	(0)		(0)	
0	DR = 10%						
1	.972	.366	.356	1.595	1.550	1.188	1.155
2	.919	.753	.692	2.118	1.946	2.433	2.236
3	.869	.626	.544	.513	.446	.717	.623
4	.822	.551	.453	1.443	1.186	1.588	1.305
5	.777	.433	.336	.835	.649	2.124	1.650
6	.735	.987	.725	1.595	1.172	1.188	.873
7	.695	.889	.618	2.118	1.472	2.433	1.691
8	.657	.456	.300	.513	.337	.717	.471
9	.621	.993	.617	1.443	.896	1.588	.986
10	.587	.433	.254	.835	.490	2.124	1.247
11	.555	.545	.302	1.595	.885	1.188	.659
12	.525	1.059	.556	2.118	1.112	2.433	1.277
13	.496	.320	.159	.513	.254	.717	.356
14	.469	.551	.258	1.443	.677	1.588	.875
15	.443	.739	.327	.835	.370	2.124	.941
16	.419	.545	.228	1.595	.668	1.188	.498
17	.396	.753	.298	2.118	.839	2.433	.963
18	.375	.626	.235	.513	.192	.717	.269
19	.354	.551	.195	1.443	.511	1.588	.562
20	.335	.433	.145	.835	.280	2.124	.712
TV	.335	(.600)					
TOTAL COST (DISCOUNTED)			$19.518		$15.932		$19.349
LESS TERMINAL VALUE (DISCOUNTED)			(.201) A		(0) B		(0) C
NET PRESENT VALUE			$19.317		$15.932		$19.349

Figure 38. Net Present Value Calculations, DIR = 4%, 90 Days/Year

		ALTERNATIVE A		ALTERNATIVE B		ALTERNATIVE C	
	DISCOUNT FACTOR	TOTAL COST	DISCOUNTED COST	TOTAL COST	DISCOUNTED COST	TOTAL COST	DISCOUNTED COST
-1	DIR = 4%	11.920	11.920				
0	DR = 10%						
1	.972	.420	.408	1.776	1.726	1.648	1.602
2	.919	.808	.743	2.299	2.113	2.893	2.659
3	.869	.867	.753	1.307	1.136	2.739	2.380
4	.822	.652	.536	1.775	1.459	2.432	1.999
5	.777	.826	.642	2.322	1.804	2.766	2.149
6	.735	1.042	.766	1.776	1.305	1.648	1.211
7	.695	.944	.656	2.299	1.598	2.893	2.011
8	.657	.697	.458	1.307	.859	2.738	1.799
9	.621	1.094	679	1.775	1.102	2.432	1.510
10	.587	.826	.485	2.322	1.363	2.766	1.624
11	.555	.600	.366	1.776	.986	1.648	.915
12	.525	1.114	.585	2.299	1.207	2.893	1.519
13	.496	.561	.278	1.307	.648	2.738	1.358
14	.469	.652	.306	1.775	.832	2.432	1.141
15	.443	1.132	.501	2.322	1.029	2.766	1.225
16	.419	.600	.251	1.776	.744	1.648	.691
17	.396	.808	.320	2.299	.910	2.893	1.146
18	.375	.867	.325	1.307	.490	2.738	1.027
19	.354	.652	.231	1.775	.628	2.432	.861
20	.335	.826	.277	2.322	.778	2.766	.927
TV	.335	(.600)		0		0	
TOTAL COST (DISCOUNTED)			$21.486		$22.717		$29.754
LESS TERMINAL VALUE (DISCOUNTED)			(.201) A		(0) B		(0) C
NET PRESENT VALUE			$21.285		$22.717		$29.754

Figure 39. Net Present Value Calculations, DIR = 4%, 135 Days/Year

		ALTERNATIVE A		ALTERNATIVE B		ALTERNATIVE C	
	DISCOUNT FACTOR	TOTAL COST	DISCOUNTED COST	TOTAL COST	DISCOUNTED COST	TOTAL COST	DISCOUNTED COST
-1	DIR = 4%	11.920		0		0	
0	DR = 10%						
1	.972	.649	.631	2.530	2.459	3.567	3.467
2	.919	.869	.799	2.500	2.298	3.405	3.129
3	.869	1.035	.899	1.860	1.616	4.145	3.602
4	.822	.820	.674	2.328	1.914	3.840	3.156
5	.777	.887	.689	2.523	1.960	3.687	2.865
6	.735	1.271	.934	2.530	1.860	3.567	2.622
7	.695	1.005	.698	2.500	1.738	3.405	2.366
8	.657	.865	.568	1.860	1.222	4.145	2.723
9	.621	1.262	.784	2.328	1.446	3.840	2.385
10	.587	.887	.521	2.523	1.481	3.687	2.164
11	.555	.829	.460	2.530	1.404	3.567	1.980
12	.525	1.175	.617	2.500	1.313	3.405	1.788
13	.496	.729	.362	1.860	.923	4.145	2.056
14	.469	.820	.385	2.328	1.092	3.840	1.801
15	.443	1.193	.528	2.523	1.118	3.687	1.633
16	.419	.829	.347	2.530	1.060	3.567	1.495
17	.396	.869	.344	2.500	.990	3.405	1.348
18	.375	1.035	.388	1.860	.698	4.145	1.554
19	.354	.820	.290	2.328	.824	3.840	1.359
20	.335	.887	.297	2.523	.845	3.687	1.235
	.335	(.600)					
TOTAL COST (DISCOUNTED)			$23.135		$28.261		$44.728
LESS TERMINAL VALUE (DISCOUNTED)			(.201) A		(0) B		(0) C
NET PRESENT VALUE			$22.934		$28.261		$44.728

Figure 40. Net Present Value Calculation, DIR = 4%, 180 Days/Year

		ALTERNATIVE A		ALTERNATIVE B		ALTERNATIVE C	
	DISCOUNT FACTOR	TOTAL COST	DISCOUNTED COST	TOTAL COST	DISCOUNTED COST	TOTAL COST	DISCOUNTED COST
-1	DIR = 8%	11.920	11.920	0		0	
0	DR = 10%						
1	.991	.366	.363	1.595	1.581	1.188	1.177
2	.973	.773	.733	2.118	2.061	2.433	2.367
3	.955	.626	.598	.513	.490	.717	.685
4	.938	.551	.517	1.443	1.354	1.588	1.490
5	.921	.433	.399	.835	.769	2.124	1.956
6	.904	.987	.892	1.595	1.442	1.188	1.074
7	.888	.889	.789	2.118	1.881	2.433	2.161
8	.871	.456	.397	.513	.447	.717	.625
9	.856	.993	.850	1.443	1.235	1.588	1.359
10	.840	.433	.364	.835	.701	2.124	1.784
11	.825	.545	.450	1.595	1.316	1.188	.980
12	.810	1.059	.858	2.118	1.716	2.433	1.970
13	.795	.320	.254	.513	.408	.717	.570
14	.781	.551	.430	1.443	1.127	1.588	1.240
15	.766	.739	.566	.835	.640	2.124	1.627
16	.752	.545	.410	1.595	1.199	1.188	.893
17	.739	.753	.556	2.118	1.565	2.433	1.798
18	.725	.626	.454	.513	.372	.717	.520
19	.712	.551	.392	1.443	1.027	1.588	1.131
20	.699	.433	.303	.835	.584	2.124	1.485
TV	.699	(.600)					
TOTAL COST (DISCOUNTED)			$22.495		$21.915		$26.892
LESS TERMINAL VALUE (DISCOUNTED)			(.419) A		(0) B		(0) C
NET PRESENT VALUE			$22.076		$21.915		$26.892

Figure 41. Net Present Value Calculations, DIR = 8%, 90 Days/Year

		ALTERNATIVE A		ALTERNATIVE B		ALTERNATIVE C	
	DISCOUNT FACTOR	TOTAL COST	DISCOUNTED COST	TOTAL COST	DISCOUNTED COST	TOTAL COST	DISCOUNTED COST
-1	DIR = 8%	11.920	11.920	0		0	
0	DR = 10%						
1	.991	.420	.416	1.776	1.760	1.648	1.633
2	.973	.808	.786	2.299	2.237	2.893	2.815
3	.955	.867	.828	1.307	1.248	2.739	2.616
4	.938	.652	.612	1.775	1.665	2.432	2.281
5	.921	.826	.761	2.322	2.139	2.766	2.547
6	.904	1.042	.942	1.776	1.606	1.648	1.490
7	.888	.944	.838	2.299	2.042	2.893	2.569
8	.871	.697	.607	1.307	1.138	2.738	2.385
9	.856	1.094	.936	1.775	1.519	2.432	2.082
10	.840	.826	.694	2.322	1.950	2.766	2.323
11	.825	.600	.495	1.776	1.465	1.648	1.360
12	.810	1.114	.902	2.299	1.862	2.893	2.343
13	.795	.561	.446	1.307	1.039	2.738	2.177
14	.781	.652	.509	1.775	1.386	2.432	1.899
15	.766	1.132	.867	2.322	1.779	2.766	2.119
16	.752	.600	.451	1.776	1.336	1.648	1.239
17	.739	.808	.597	2.299	1.699	2.893	2.138
18	.725	.867	.629	1.307	.948	2.738	1.985
19	.712	.652	.464	1.775	1.264	2.432	1.732
20	.699	.826	.577	2.322	1.623	2.766	1.933
TV	.699	(.600)					
TOTAL COST (DISCOUNTED)			$25.277		$31.705		$41.666
LESS TERMINAL VALUE (DISCOUNTED)			(.419) A		(0) B		(0) C
NET PRESENT VALUE			$24.858		$31.705		$41.666

Figure 42. Net Present Value Calculations, DIR = 8%, 135 Days/Year

		ALTERNATIVE A		ALTERNATIVE B		ALTERNATIVE C	
	DISCOUNT FACTOR	TOTAL COST	DISCOUNTED COST	TOTAL COST	DISCOUNTED COST	TOTAL COST	DISCOUNTED COST
-1	DIR = 8%	11.920		0		0	
0	DR = 10%						
1	.991	.649	.643	2.530	2.507	3.567	3.535
2	.973	.869	.846	2.500	2.433	3.405	3.313
3	.955	1.035	.988	1.860	1.776	4.145	3.958
4	.938	.820	.769	2.328	2.184	3.840	3.602
5	.921	.887	.817	2.523	2.324	3.687	3.396
6	.904	1.271	1.149	2.530	2.287	3.567	3.225
7	.888	1.005	.892	2.500	2.220	3.405	3.024
8	.871	.865	.753	1.860	1.620	4.145	3.610
9	.856	1.262	1.080	2.328	1.993	3.840	3.287
10	.840	.887	.745	2.523	2.119	3.687	3.097
11	.825	.829	.684	2.530	2.087	3.567	2.943
12	.810	1.175	.952	2.500	2.025	3.405	2.758
13	.795	.729	.580	1.860	1.479	4.145	3.295
14	.781	.820	.640	2.328	1.818	3.840	2.999
15	.766	1.193	.914	2.523	1.933	3.687	2.824
16	.752	.829	.623	2.530	1.903	3.567	2.682
17	.739	.869	.642	2.500	1.848	3.405	2.516
18	.725	1.035	.750	1.860	1.349	4.145	3.005
19	.712	.820	.584	2.328	1.658	3.840	2.734
20	.699	.887	.620	2.523	1.764	3.687	2.577
	.699	(.600)					
TOTAL COST (DISCOUNTED)			$27.591		$39.327		$62.380
LESS TERMINAL VALUE (DISCOUNTED)			(.419) A		(0) B		(0) C
NET PRESENT VALUE			$27.172		$39.327		$62.380

Figure 43. Net Present Value Calculations, DIR = 8%, 180 Days/Year

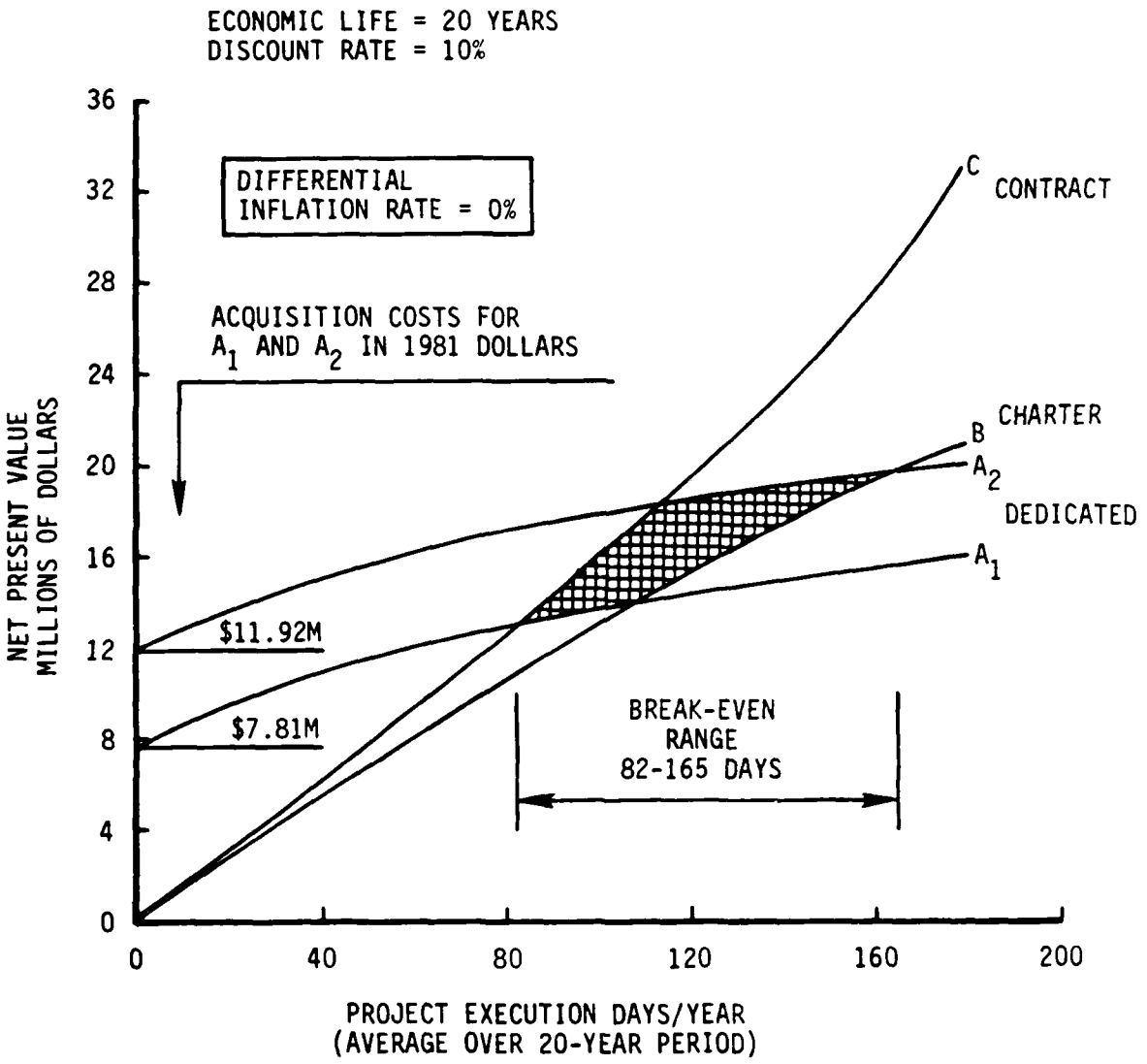

Figure 44. Net Present Value Comparisons, DIR = 0%

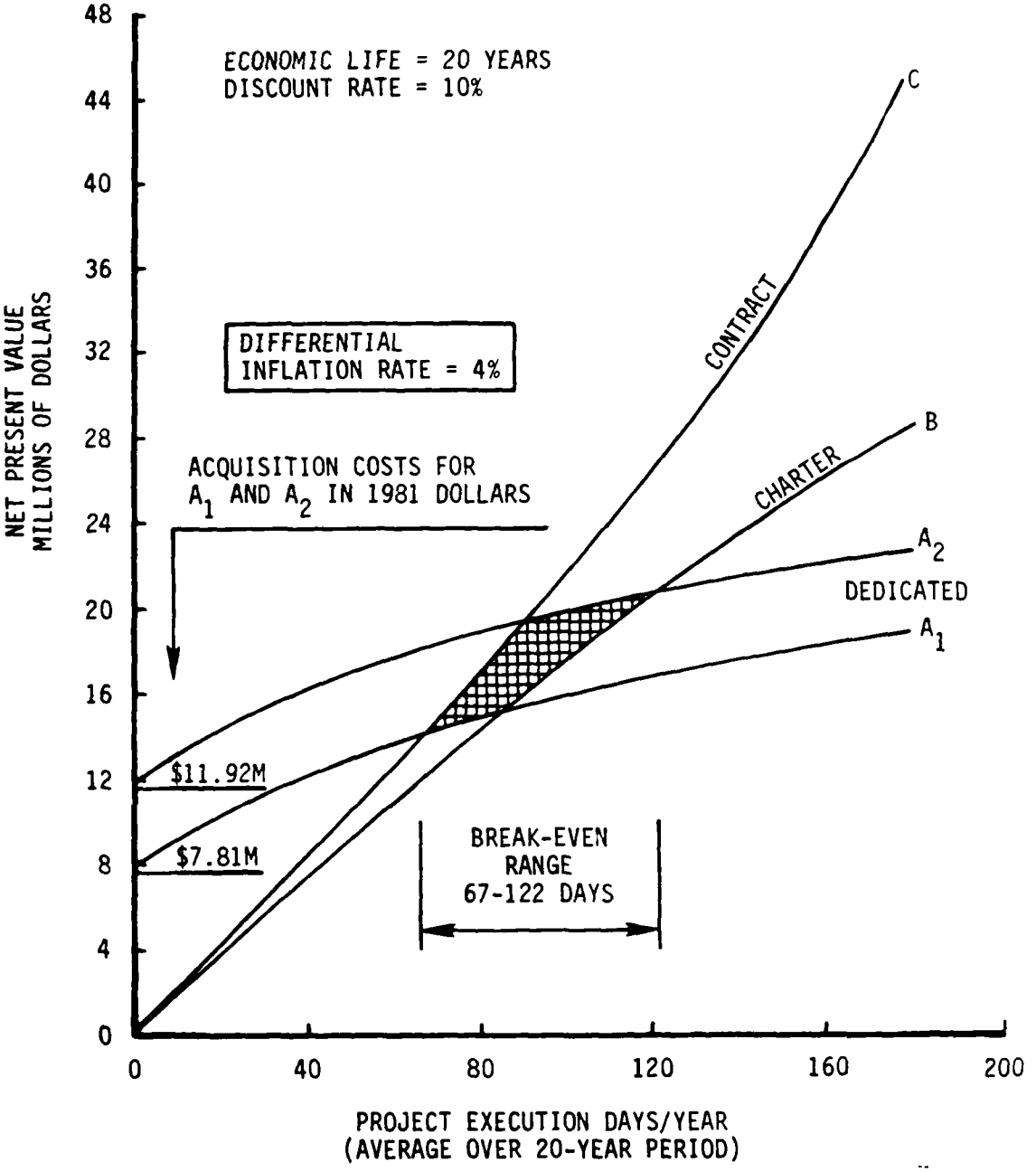

Figure 45. Net Present Value Comparisons, DIR = 4%

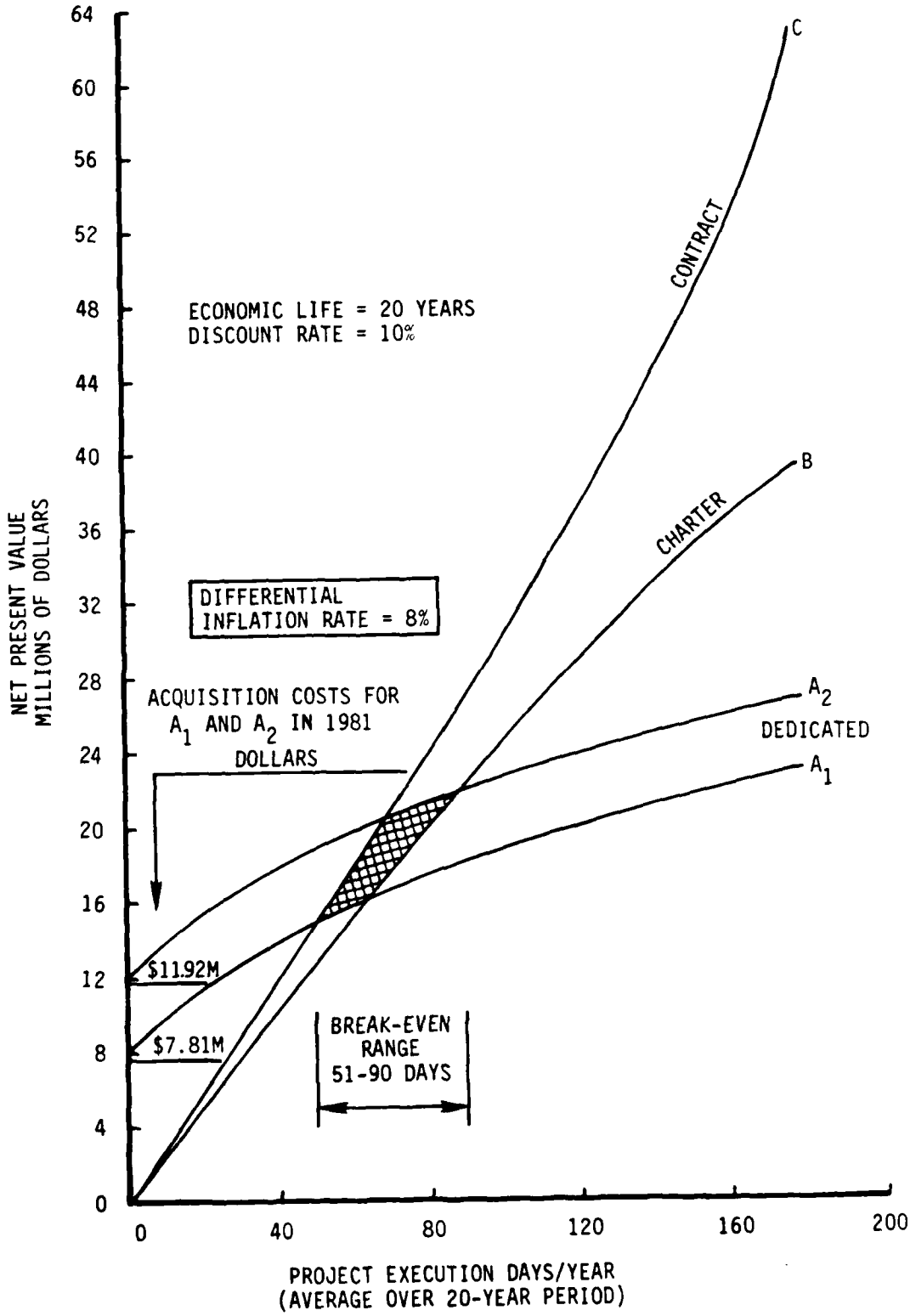

Figure 46. Net Present Value Comparisons, DIR = 8%

5.0 FUEL OIL (DIESEL #2) CONSUMPTION ANALYSIS

A large percentage of the operational costs are for the consumables, primarily the fuel oil required in execution of the projects. The amount of fuel required gives a relative comparison of the efficiency of the alternatives. The amount of fuel in long tons needed to perform the individual scenarios is estimated in GMDI's Preliminary Design Study, Reference 11. The totals and per day rates are summarized here for the three alternatives:

Total Number of Long Tons Required	Scenario 1	2	3
A (Dedicated)	691 LT	157 LT	550 LT
B (Charter)	1545	307	795
C (Contract)	562	114	391

Number of Long Tons/Day	Scenario 1	2	3
A (Dedicated)	4.9 LT/Day	4.1 LT/Day	6.3 LT/Day
B (Charter)	11.4	7.1	8.8
C (Contract)	5.9	5.7	8.9

On a per day basis in all three scenarios, Alternative A is the most efficient in terms of fuel consumption. In terms of total fuel consumed, Alternative C is the most efficient. In all cases analyzed here, Alternative B (the status quo option) is the least efficient. Since very high escalation rates are projected for Diesel #2 fuel oil prices, the total dollar cost of fuel consumed over the 20-year economic life was investigated for the baseline case of 135 days/year average project execution level. One long ton is roughly equivalent to 8.5 barrels and the 1978 price of one long ton is $106.

As prescribed in Reference 7 the short term escalation rates used are as follows:

From 1978 to	1979	16%
1979	1980	16%
1980	1981	14%
1981	1982	14%

The long term escalation rate used is a 9% differential inflation rate combined with the 10% discount factor. The factor used for escalating 1978 prices to 1982 is (1.16)(1.16)(1.14)(1.14) = 1.74874. Factors used for escalating fuel costs from 1982 through 2002 are taken from page 16 of Appendix E of Reference 5. Using the above factors the $106 price of one long ton of Diesel #2 fuel oil becomes $185/L.T. in 1982.

The total amount of fuel oil consumed for the baseline case of 135 days/year workload over the 20-year economic life is:

	Long Tons	Barrels
A (Dedicated)	13,068	111,078
B (Charter)	26,036	221,306
C (Contract)	11,852	100,742

The dollar value of fuel oil consumed is estimated three ways; constant 1978 dollars, constant 1982 dollars and in net present value with a 9% differential inflation rate.

	1978	1982	NPV
A (Dedicated)	$1.385M	$2.422M	$2.213M
B (Charter)	2.760	4.826	4.404
C (Contract)	1.256	2.197	2.006

The net present value calculations for each year are provided in Figure 47.

	DISCOUNT FACTOR	ALTERNATIVE A		ALTERNATIVE B		ALTERNATIVE C	
		TOTAL COST	DISCOUNTED COST	TOTAL COST	DISCOUNTED COST	TOTAL COST	DISCOUNTED COST
-1	DIR = 9%	$185/L.T.		$185/L.T.		$185/L.T.	
0	DR = 10%	(1982$)		(1982$)		(1982$)	
1	.995	115,669	115,091	171,279	170,423	91,571	91,113
2	.986	141,805	139,820	310,303	305,959	123,269	121,543
3	.977	95,649	93,449	172,020	168,064	113,074	110,473
4	.969	108,254	104,898	238,937	231,530	102,878	99,689
5	.960	144,215	138,446	314,011	301,451	118,449	113,711
6	.951	115,669	110,001	171,279	162,886	91,571	87,084
7	.942	141,805	133,580	310,303	292,305	123,269	116,119
8	.934	95,649	89,336	172,020	160,667	113,074	105,611
9	.925	108,254	100,135	238,937	221,017	102,878	95,162
10	.917	144,215	132,245	314,011	287,948	118,449	108,618
11	.909	115,669	105,143	171,279	155,693	91,571	83,238
12	.900	141,805	127,625	310,303	279,273	123,269	110,942
13	.892	95,649	85,319	172,020	153,442	113,074	100,862
14	.884	108,254	95,697	238,937	211,220	102,878	90,944
15	.876	144,215	126,332	314,011	275,074	118,449	103,761
16	.868	115,669	100,401	171,279	148,670	91,571	79,484
17	.860	141,805	121,952	310,303	266,861	123,269	106,011
18	.852	95,649	81,493	172,020	146,561	113,074	96,339
19	.845	108,254	91,475	238,937	201,902	102,878	86,932
20	.837	144,215	120,708	314,011	262,827	118,449	99,142
		$2,422,368		$4,826,200		$2,196,964	
TOTAL COST (DISCOUNTED)			$2,213,146		$4,403,773		$2,006,778
FUEL OIL							
NET PRESENT VALUE			$2.213M		$4.404M		$2.007M

Figure 47. Fuel Calculations. Total Cost and NPV, 135 Days/Year

6.0 CONCLUSIONS

In terms of real dollars, both 1978 and escalated, Alternative A (the dedicated platform) has the lowest total life cycle cost for the three cases of 90, 135 and 180 days per year project execution levels. By plotting the life cycle costs as a function of project execution days/year (as done in Figures 1 and 2), savings to investment ratios (SIR) of one are determined by the intersection of the curves. The four intersections on Figure 1 (constant 1978 dollars) yield a range from 42 to 82 days where the SIR = 1. On Figure 2 (current year dollars - which best represents the real situation in terms of cost) the four intersections yield a range of from 22 to 35 days.

What does this tell us? It means that in current year dollars, if project execution averages 35 days every year from 1982 to 2002, $26 million total or $1.3 million each year will be expended and that by using the YFNB Dedicated platform (Alternative A) the dollar savings over the status quo option (Alternative B, charter) will equal the YFNB acquisition cost of $11.92 million.

$$\text{i.e.,} \quad \frac{\text{Savings}}{\text{Investment}} = \text{SIR} \approx \frac{\$11.92\text{M}}{\$11.92\text{M}} = 1.0$$

Similarly, in today's dollars (no escalation) if project execution averages 82 days every year from 1982 to 2002, $17.7 million total or $890,000 each year will be expended. By using the YFNB (Alternative A), the dollar savings over the status quo (Alternative B) will equal the YFNB acquisition cost of $9.46 million.

$$\text{i.e.,} \quad \frac{\text{Savings}}{\text{Investment}} = \text{SIR} = \frac{\$9.46\text{M}}{\$9.46\text{M}} = 1.0$$

For budget and POM preparation the escalated or current year dollar values should be used.

Savings to investment ratios may also be calculated for the 90, 135 and 180 day/year project execution levels. They are presented here as savings gained from using Alternative A, the YFNB dedicated platform vice

Alternative B, the charter - status quo option. If one compares A with C, the contract option, the savings are greater and SIR's will be higher.

Project Execution Days/Year	90	135	180
Constant 1978 Dollars			
I = $9.46 M			
Savings	$10.32M	$16.59M	$21.22M
SIR	1.09	1.75	2.24
Current Year Dollars			
I = $11.92 M			
Savings	$34.81M	$57.44M	$72.62M
SIR	2.92	4.82	6.09

This economic analysis would not be complete without the results of the net present value (NPV) calculations. The net present values of total life cycle costs are sensitive to both project execution level and differential inflation rate. At the 90 day/year level, Alternative B (the status quo option) has the lowest NPV from 0% differential inflation rate through 8%, becoming nearly equal to the NPV of A at the 8% rate. At the 135 day/year level Alternative B has the lowest NPV only from 0% differential inflation rate to 2 1/2%. For rates higher than 2 1/2%, Alternative A has the lowest NPV as shown in Figure 3. Also shown in this figure is the effect of a lower acquisition cost for A. If the acquisition cost is lowered from $11.92M to $9.93M, then the NPV of A would be the lowest even at the 0% differential inflation rate. The lower curve plotted in Figure 3 (designated A1) represents the same data as for A2 but with an acquisition cost of $7.81M which corresponds to the alternative preliminary design concept of the converted drillship. (See GMDI's Preliminary Design Study, Reference 11.) Alternative A has the lowest NPV for the differential inflation rates from 0% and up at the 180 day/year project execution level.

The effect of acquisition cost variances on Alternative A and increases in project execution days on Alternatives B and C are readily seen from the data presented in Figures 44, 45 and 46. If we compare the two Alternative A curves with Alternative B, we find that Alternative A has the lowest NPV within a range of project execution days/year as follows:

Differential Inflation Rate	Range of Days/Year
0%	110 - 165 or more
4	85 - 122 or more
8	65 - 90 or more

Information from References 6, 7, 8, 9 and 11 which discuss inflation rates and cost estimating, indicates that for the purpose of estimating life cycle costs in ocean construction work, a differential inflation rate of at least 4% should be used, perhaps as high as 8%. This analysis considers the range from 0 to 8%. Figure 3 (discussed in the Summary Section), utilizing data from the baseline case of 135 days/year workload, shows that Alternative A has the lowest present value in the area of concern 4 to 8%.

The results of this analysis highlight basic differences between the alternatives. Since Alternatives B and C have costs that are primarily operational, the life cycle costs are very sensitive to inflationary price changes and to the number of project execution days. Budgetary estimates for any one project in any one year will be more uncertain for Alternatives B and C than for A. Alternatives B and C are highly sensitive to weather days, downtime and other unpredictable events. For every day more on a project, the costs rise much faster with B and C than they do with A. A major portion (approximately one half) of the life cycle costs for Alternative A is the acquisition cost. This cost is projected out only a few years therefore has less uncertainty associated with it and once it is expended, inflationary price increases or the number of project execution days have no further effect upon it.

The efficiency of the three alternatives may be compared with respect to fuel consumption and performance time. Alternative A is most efficient with respect to fuel consumption, though Alternative C (highest cost option) is a

close second. The fuel consumption rate per day of C is higher than for A therefore C is more sensitive to lost time due to unpredictable events than A. The fuel consumption efficiency of the status quo option B is poor, requiring over twice as much fuel as either A or C. With respect to performance time of project execution, Alternative C is the most efficient. Alternative B is the least efficient with respect to performance time.

Since the status quo Alternative B depends solely upon availability of specialized equipment and platforms of opportunity at the time of project execution, option B contributes the least to Fleet readiness and incurs the most uncertainty and highest risk of the three alternatives. It is felt that either Alternative A (the dedicated platform) or Alternative C (the contract method) is about equal with respect to Fleet readiness and degree of uncertainty and risk but of course C is the highest cost alternative.

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